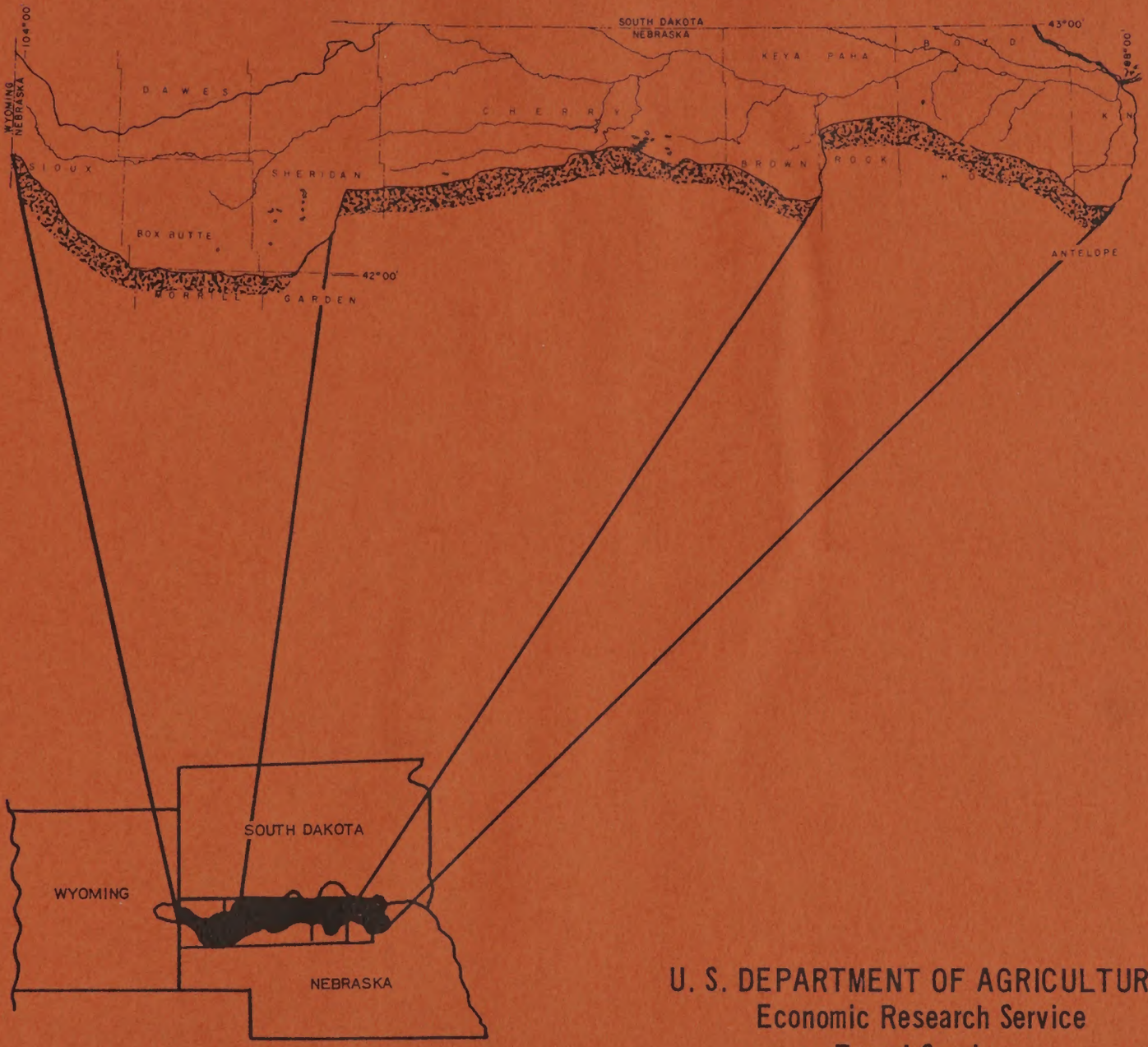
NIOBRARA RIVER BASIN
Nebraska
WATER AND RELATED LAND RESOURCES



U. S. DEPARTMENT OF AGRICULTURE
Economic Research Service
Forest Service
Soil Conservation Service

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Bureau of Outdoor Recreation

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Nebraska Natural Resources Commission

Natural Resource Districts

Nebraska Game and Parks Commission

Nebraska Department of Water Resources

University of Nebraska:

- Agricultural Experiment Station
- Agricultural Extension Service
- Conservation and Survey Division

PHOTOGRAPHS

All photographs used in this report are from Soil Conservation Service files unless otherwise noted.

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U.S. DEPARTMENT OF AGRICULTURE
NIOBRARA RIVER BASIN, NEBRASKA

SUMMARY

General

The Niobrara River Basin study included the adjacent drainage of Ponca Creek, tributary to the Missouri River. The combined area drained by these two streams is approximately 13,866 square miles, or some 8,874,300 acres. About 84 percent of this area, or 7,444,600 acres, is located in 15 northern Nebraska counties extending from the Wyoming state line on the west to an eastern point where the Niobrara River enters the Missouri River near the village of Niobrara, Nebraska.

This survey report prepared by the U.S. Department of Agriculture (USDA) is for the purpose of promoting the conservation, utilization, and potential development of the water and related land resources in the Nebraska portion of the Niobrara River Basin. The report is based upon a study of upstream watershed needs and opportunities for flood prevention; agricultural, municipal, and industrial water supply; fish and wildlife habitat; recreation facilities; water quality control; and environmental quality.

The main objectives of the USDA study are to (1) inventory the natural resources of the basin; (2) analyze the basin's economy relative to present conditions, historic trends, and projections; (3) determine the cause, extent, and frequency of the basin's resource problems; (4) determine the present and future need for development based on resource problems and projected economic activity; (5) describe the pertinent existing water and related land resource projects and programs; (6) describe the physical potential or capability of the basin to supply water and related land resources for development to meet identifiable needs; and (7) describe the opportunities for development through USDA projects and programs and determine their estimated impacts upon the basin.

Problems and Needs

The principal water and related land resource problems and needs for the basin are:

1. Floodwater and sediment damages occur on 130,700 acres. The

amount of damage to agricultural lands, urban communities, transportation network, etc. was evaluated on 76,500 acres located in the upland depressional and flatlands and 47,000 acres along the main stem. These current average annual damages are estimated to be $308,000 for the upstream areas and $62,000 along the main stem. Monetary damages are relatively low, due to infrequent high flows and limited development on the floodplains. The most severe floods occur during the snowmelt period, when ice jams often compound the problem.

2. Sheet, wind, gully, and streambank erosion are severe problems in many areas of the basin. They result in the loss of valuable topsoil, the total destruction of land, and the deposition of sediment in undesirable locations. It is estimated 5,777,700 acres of land in the basin, about 77 percent, are subject to erosion damage. Of this, some 777,750 acres have gully erosion problems, causing average annual damages of $235,000.

3. Approximately 325,000 acres of agricultural land have a problem of excess water for most cultivated crops. Impaired drainage was found to be a serious problem on 145,900 acres having excess water problems, with 119,000 acres needing project action for alleviation.

4. The variability in the amount and seasonal distribution of precipitation often results in periods of drought. These water shortages have a detrimental effect on the crops grown in this area. Additional irrigation is needed to assure a stable agriculture. Water shortages also have a detrimental effect on fish and wildlife habitat, population and propagation. There is an urgent need for supplemental water supply during drought periods.

5. Some areas in the basin are experiencing decreasing ground water levels. Lowering of the water table in various areas is considered to be potentially serious. Proper management and regulation in the development and use of the basin's ground water resources are needed.

6. Major range and forest problems are associated with fires during drought periods, over grazing by livestock, and damage to many trees by Dutch elm disease. Such conditions add to increased runoff and erosion damages, the loss of cover needed for wildlife, and the degrading of the natural beauty of the area.

7. Municipal, industrial,and agricultural wastes and erosion contribute pollutants to many streams in the basin. Additional treatment is needed to reduce municipal and industrial wastes. More land treatment measures are needed to control erosion and reduce sediment and feedlot runoff. Proper management and use of herbicides, pesticides, and commercial fertilizers is required to prevent undesirable amounts of chemical residues from entering the streams.

8. Although this basin has an abundance of natural water based recreation and wildlife habitat, there is need for both additional development and improvement of existing facilities and habitat. Optimum use of new or existing facilities is dependent on accessibility and travel time required. Projected recreational demands are expected to increase from the current 1,185,100 visitor-days to 2,482,700 visitor-days by 2020.

9. Livestock water requirements will increase from the current use of 14,900 acre feet to 33,500 acre feet by 2020. Ground water will continue to be the major source of supply. Currently surface water supplies an estimated 25 percent of the total requirement.

10. Municipal, industrial, and rural domestic water requirements will increase from an estimated 1960 requirement of 5,020 acre feet to only 6,050 acre feet by 2020 because the projected population will decrease by 7,900 during this time. Ground water has been used exclusively for municipal and rural domestic use. It is expected all future needs will be met by this source. Some rural water supply systems are needed in Keya Paha, Boyd and Knox counties to meet the future projected requirements for rural domestic and livestock use.

11. Adequate conservation treatment and management of the agricultural and forested lands is a continuing and important need throughout the basin. Currently 3,790,000 acres are adequately treated. About 47 percent of the basin needs treatment measures installed. It is estimated that 1,897,000 acres need both management and vegetative and mechanical practices. The remaining 1,403,000 acres need only management practices to achieve adequate protection.

Findings and Conclusions

The declining basin population is expected to continue through the year 2020, declining from a present 39,300 to 33,000. Farm population is also expected to decline from 17,000 currently to 10,000 by 2020.

The gross value of the total agricultural output is projected to increase about 286 percent by 2020. This will be accomplished by changes in land use, yield increases due to technology and heavier fertilizer applications, additional irrigated acreage, improved irrigation management, continued improvement in the conservation of soil and water resources, and increased livestock production.

The average amount of land developed for irrigation in the years 1966-1970 was 145,000 acres. An additional 160,000 acres of private irrigation development is anticipated by 2020. Nearly all of this will be ground water development, with a major portion located in Box Butte and Holt Counties. Both of these areas are already experiencing a

falling water table with the additional development making the problem more acute. The success of future development is dependent on legislative action that would regulate private ground water development and the importation of supplemental water supplies.

Enhancement of the natural beauty of the basin will result from improvement of woodland management. Additional windbreaks and shelterbelts will add to the beauty of the landscape, increase protection to farmsteads and crops, and furnish additional wildlife habitat.

Programs of the U.S. Department of Agriculture will continue to improve the conservation, development, and utilization of land, water, wildlife and related resources.

Specific conclusions of this study are:

1. Information, technical assistance, and cost-sharing conservation programs should be intensified throughout the basin to maintain and increase the use of conservation measures on all land. Land treatment measures should treat critical sediment producing areas; improve natural water courses; improve range, pasture and forest land; improve irrigation efficiencies; and provide necessary practices to control barnyard and feedlot pollution. It is estimated an additional 1,195,000 acres of agricultural land will be treated by 2020. Of this area, 705,000 acres will require management, vegetative, and/or mechanical practices, with 490,000 acres requiring management practices only. The total cost of the needed land treatment measures is estimated to be $30,202,000. This includes $1,870,000 for treatment of 55,000 acres of forest and woodland.

2. Opportunities exist to improve or assist in the installation of new water supply and sewage treatment facilities. Seventeen communities need improved water supply systems; six communities need improved sewage treatment facilities; and six communities need new sewage systems. The total cost for the needed community facilities is estimated to be $1,244,600.

3. Currently there appears to be little potential for Public Law 83-566 small watershed projects in the basin. Damage reduction benefits are less than the expenditures required to construct measures to reduce the damage. Opportunities for reservoir storage were identified in 46 potential sites in 14 upstream watersheds.

4. It is recommended that a Resource Conservation and Development Project be authorized for Boyd, Brown, Cherry, Holt, Keya Paha and Rock Counties to coordinate federal, state and local efforts to develop the resources of the six county area for economic, wildlife, recreation and community improvement.

USDA-SCS-LINCOLN, NEBR. 1974 S.L.-4,308

U.S. DEPARTMENT OF AGRICULTURE
NIOBRARA RIVER BASIN, NEBRASKA

I. INTRODUCTION

This report presents the results from the study and analysis of the physical and economic potential for the development of water and related land resources in the Niobrara River Basin. The goals of the State of Nebraska, recognized problems, and present and future needs are the basis of this study.

The Niobrara River Basin report was prepared by the U.S. Department of Agriculture (USDA), under authority of Section 6 of the Watershed Protection and Flood Prevention Act, as amended (Public Law 83-566, enacted in August, 1954). This cooperative Type IV river basin survey was authorized for investigations and studies by the Administrator of the Soil Conservation Service on June 15, 1966. This river basin study was requested by the Niobrara River Association through the Nebraska Soil and Water Conservation Commission, the state coordinating agency (presently entitled the Nebraska Natural Resource Commission).

The Nebraska Soil and Water Conservation Commission developed a plan of work setting forth their objectives for resource development and enumerating the assistance desired from various state and federal agencies. In addition to the USDA, assistance has been requested from the Bureau of Reclamation; Bureau of Sport Fisheries and Wildlife; Corps of Engineers; Conservation and Survey Division and Extension Service, University of Nebraska; Nebraska Department of Water Resources; Nebraska Game and Parks Commission; Nebraska Department of Health; and similar agencies in the states of Wyoming and South Dakota. Several of the federal agencies have water and related land resource studies underway or are contemplating studies. The Commission desires to have a coordinated study by all agencies concerned with water and land resource development.

Agencies of the United States Department of Agriculture were requested to:

1. Compile statistical material on the agricultural economy of the basin.

2. Inventory soil, water and related resource problems on a watershed basis.

3. Analyze projected improvements in agricultural technology, growth of markets, and the need for land and water resource development.

4. Evaluate the effects of the recommended water and related land resource development on the basin's economy.

5. Determine the physical and economic feasibility of small watershed project action.

Investigation and survey activities of the U. S. Department of Agriculture were performed under the direction of the USDA Field Advisory Committee, composed of one representative each from the Soil Conservation Service, the Economic Research Service, and the Forest Service. The committee prepared a plan of work, coordinated the Department's survey procedures and activities, arranged for field review of problems, recommended actions and reports, and guided the working relationships with the Nebraska Soil and Water Conservation Commission and other state and federal agencies.

USDA representatives analyzed each Soil and Water Conservation District's (presently incorporated into the Natural Resources Districts) water and related land resource problems and needs by delineated watershed areas, after consultation with the District Supervisors, the staff of the local Soil Conservation Service Field Offices, and local officials and residents.

The potential water and related land resource development proposals in this report are those found to be needed by the USDA agencies carrying out the Study. However, the development of a comprehensive Niobrara River Basin resource development plan cannot be accomplished by combining unilateral, single-agency plans. It can only be accomplished by the joint efforts of all concerned in a coordinated plan formulation such as is outlined in the current Level "B" Study authorized by the U.S. Water Resources Council for the Nebraska portion of the Platte River Basin or by some other coordinated federal-state-local planning process.

II. NATURAL RESOURCES OF THE BASIN

An endowment of physical resources is basic to the potential development of land, water, and related resources development. Climate, physiography, geology, soils, land use, water quality and quantity, fish and wildlife, and natural environment are factors which must be considered in planning resource development. Each factor is important and makes a unique contribution to the physical capacity and potential development of the basin. This chapter describes and inventories those resources which are important to the water and related land resource development of the basin.

A. Location and Size

The Niobrara River heads in eastern Wyoming and flows eastward across northern Nebraska to its junction with the Missouri River. The Ponca Creek drainage area lies adjacent to the Niobrara River, and is included in this Niobrara River Basin study. Ponca Creek heads in South Dakota and enters the Missouri River about five miles upstream from the original mouth of the Niobrara River. Both streams discharge into the Missouri River just above Lewis and Clark Lake, a main stem reservoir formed by Gavins Point Dam located above Yankton, South Dakota.

The Niobrara River Basin has a drainage area of 13,866 square miles. The Niobrara River drainage is 13,026 square miles in size with the remaining 840 square miles located in Ponca Creek. About 84 percent of the basin or 7,444,600 acres is located in Nebraska with 1,063,000 acres located in South Dakota and 366,700 acres in Wyoming. Additional drainage area details are shown in Table II-1.

The Niobrara River has a length of about 350 miles. The basin has an average width of about 40 miles. The headwaters in eastern Wyoming are in a mountainous and high plains area where the maximum elevation is about 6,100 feet above sea level. The basin, in western Nebraska, is characterized by flat table lands bordered on the north by the Pine Ridge area. In the central part of the basin, the stream flows through the Sandhills region. In this region which includes Cherry, Brown, Sheridan and Rock Counties, the river becomes incised, tumbling over succeeding layers of bedrock until it outlets into the Missouri River at an elevation of about 1,220 feet above sea level. The lower half of the Niobrara River has a valley floor which is narrow and approximately 300 feet below the bordering uplands.

TABLE II-1.--DRAINAGE AREA 1/
NIOBRARA RIVER BASIN, NEBRASKA

Item	Unit	Niobrara	Ponca	Total
Nebraska	Acres	7,166,400	278,200	7,444,600
	Sq.Mi.	11,197	435	11,632
South Dakota	Acres	803,800	259,200	1,063,000
	Sq.Mi.	1,256	405	1,661
Wyoming	Acres	366,700	-	366,700
	Sq.Mi.	573	-	573
Total	Acres	8,336,900	537,400	8,874,300
	Sq.Mi.	13,026	840	13,866

1/ From 1967 Watershed Conservation Needs Inventory

The Niobrara River is generally fast-flowing, increasing in velocity as it passes through Cherry, Brown, and Rock Counties where its gradient increases. The river has a high base flow from ground water contributed primarily by the Sandhills region. The quantity of flow does not vary greatly throughout the year.

The Ponca Creek drainage area is long and narrow, being about ten miles in width and nearly 90 miles in length. The upper 32 miles of the watershed is in South Dakota. The stream heads west of Gregory, South Dakota, and enters Nebraska about two miles northeast of Naper, Nebraska. The stream flows through gently rolling tablelands which are remnants of sedimentary plains until it reaches Boyd County, Nebraska, where it enters hilly terrain. In the lower Ponca, bluffs adjacent to the main valley average about 300 feet above the valley floor. The flood plain is undefined in the upper reaches, and varies up to one-fourth mile in width in the lower reaches. About four percent of the watershed area is in flood plain.

The Niobrara River and Ponca Creek drain all of Box Butte and Keya Paha Counties, and portions of 13 other counties in Nebraska. Table II-2 lists the counties involved, the total area of each county, and the portion of each county within the basins.

An inventory of the area located in Nebraska shows that there are 7,089,900 acres of private agricultural land; 199,500 acres of federally owned land; 84,800 acres of transportation, urban, and built-up; and 70,400 acres of large and small water areas in the basin (see Table II-3).

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

LEGEND

STATE BOUNDARY	RIVER BASIN BOUNDARY
COUNTY BOUNDARY	SUBBASIN BOUNDARY
HIGHWAY	FEDERAL LANDS
RAILROAD	INDIAN LANDS
TOWN UNDER 2500	STATE PARK
OVER 2500	STATE RECREATION AREA
DRAINAGE	STATE WAYSIDE AREA
LAKE OR RESERVOIR	STATE SPECIAL USE AREA
	STATE FISHERY

N

SCALE 10 0 10 20 30 40 MILES

SCALE 1/1,200,000

LOCATION MAP
NIOBRARA RIVER BASIN
NEBRASKA

SOURCE
S.C.S. DRAWING 5,3-28,978, AND INFORMATION FROM S.C.S. FIELD TECHNICIANS NEBRASKA GAME AND PARKS COMMISSION
LAMBERT CONFORMAL CONIC PROJECTION

USDA-SCS-LINCOLN, NEBR. 1974

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TABLE II-2.--AREA BY COUNTIES
NIOBRARA RIVER BASIN, NEBRASKA

County	Total County Area 1/	Area of County in Basin	
	Acres	Acres	Percent
Antelope	545,920	97,500	17.9
Box Butte	682,900	682,900	100.0
Boyd	350,700	311,100	88.7
Brown	783,360	464,400	59.3
Cherry	3,848,320	2,360,800	61.3
Dawes	889,600	284,000	31.9
Garden	1,105,920	7,400	.7
Holt	1,546,880	668,600	43.2
Keya Paha	495,400	495,400	100.0
Knox	729,600	293,400	40.2
Morrill	913,280	18,100	2.0
Rock	650,880	127,300	19.6
Scotts Bluff	476,800	800	.2
Sheridan	1,587,840	1,067,900	67.3
Sioux	1,320,320	565,000	42.8
Total	15,927,720	7,444,600	--

1/ Source: U.S. Department of Commerce, Bureau of Census, Area Measurement Reports, 1960.

TABLE II-3.--LAND AND WATER INVENTORY
NIOBRARA RIVER BASIN, NEBRASKA

Item	Acres
Private Agricultural Land	7,089,900
Federal Land	199,500
Transportation, Urban, & Built-up	84,800
Large Water 1/	55,500
Small Water	14,900
Total	7,444,600

1/ Includes 14,000 acres within federal ownership. Large water includes bodies of water over 40 acres in size and streams over 1/8 mile in width.

B. Climate

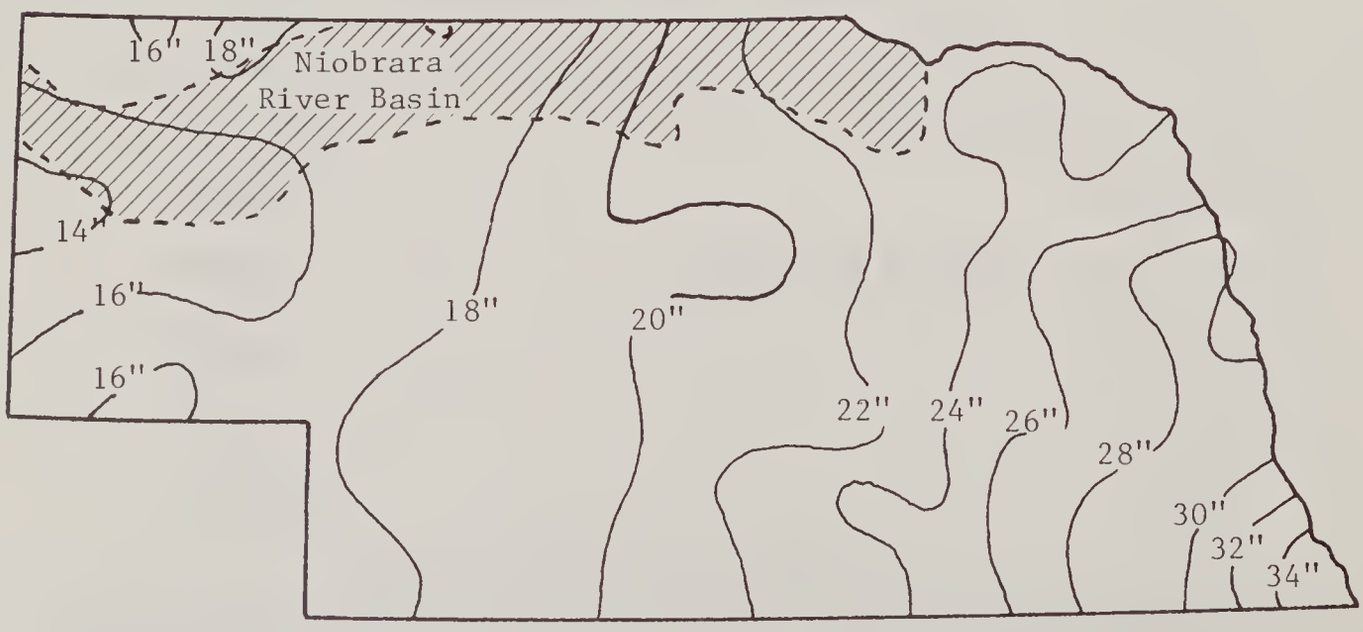
The inland location of the Niobrara River Basin results in a wide variety of weather. The climate is characterized by low humidity and rather large variations in temperature and precipitation from month to month and year to year. Low temperatures combined with high winds give snow a powdery texture and a penetrating quality.

The basin is located in the path of cold Canadian air mass outbreaks during the winter. Also in the longitude of the Black Hills the basin comes under the influence of Chinook winds. Extreme cold waves are usually of short duration. The winter season occasionally becomes severe for both man and beast, but generally the climate is conducive to vigorous, year around, outdoor activity free from the oppressive heat of summer and the penetrating cold of winter.

The Niobrara River Basin's weighted annual precipitation, based on the 1931-1960 period, is approximately 18 inches -- ranging from about 14 inches in the headwaters to almost 24 inches at the lower part of the basin near Niobrara, Nebraska (Figure II-1). Daily and monthly precipitation varies considerably at individual weather stations. Figure II-2 is a graphical presentation of normal monthly precipitation and extremes of record at four selected stations representative of the basin. Approximately two-thirds of the total annual precipitation falls during the growing season -- May through September. Normal monthly rainfall is highest in June and lowest in September.

Snowfall has been recorded in at least trace amounts in every month of the year in some part of the basin since record-keeping began.

FIGURE II-1.--MEAN ANNUAL PRECIPITATION IN INCHES, BASED ON THE PERIOD 1931-1960 NIOBRARA RIVER BASIN, NEBRASKA



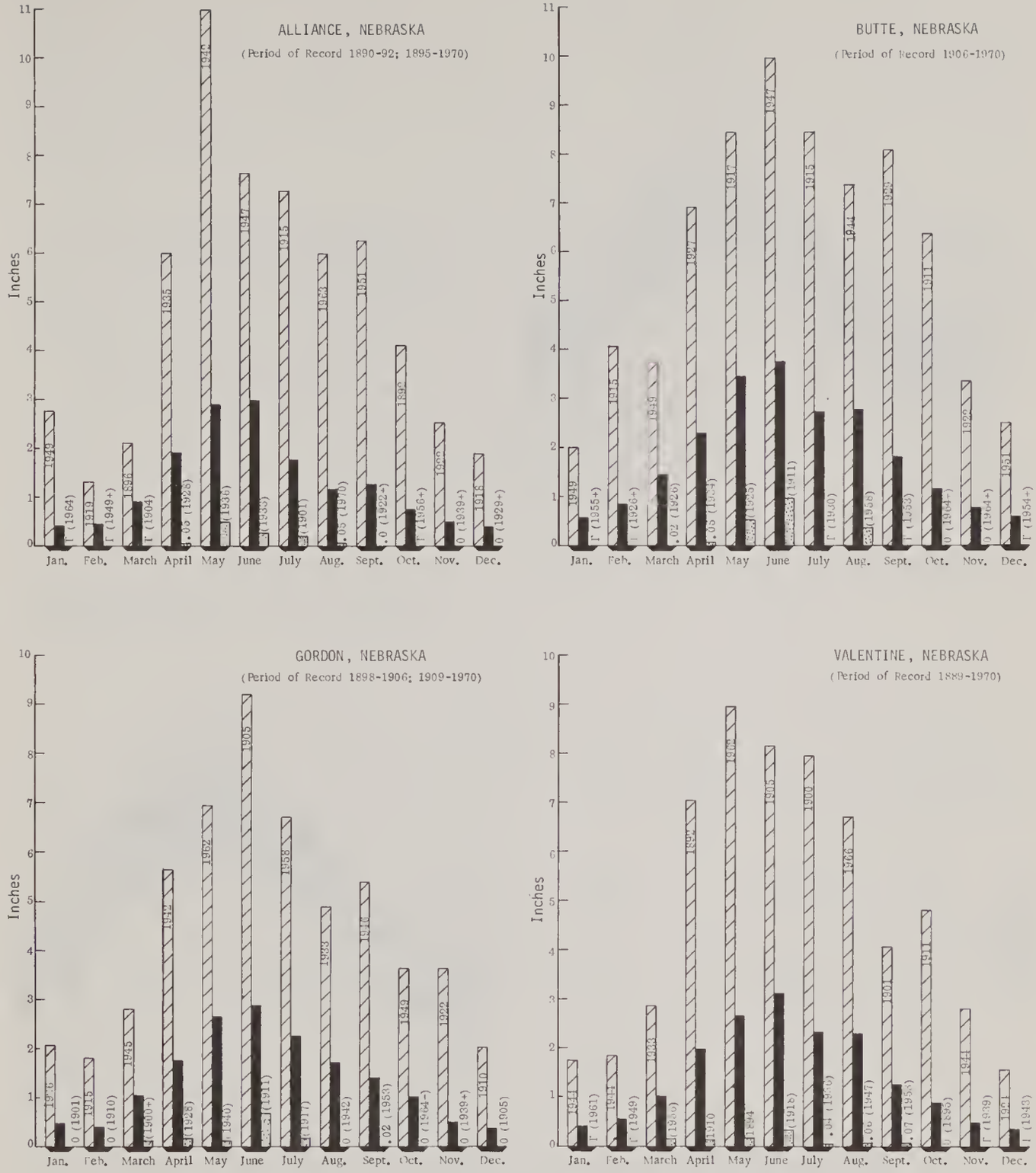
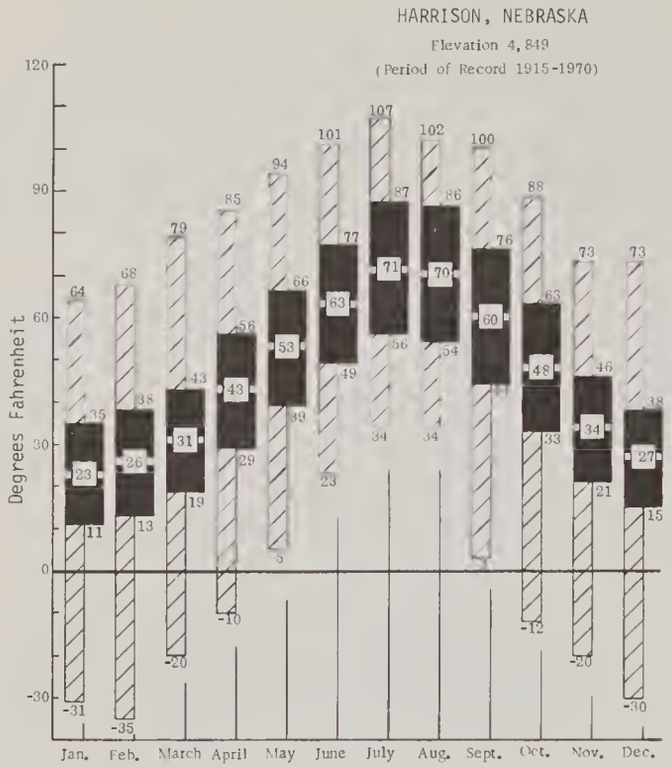
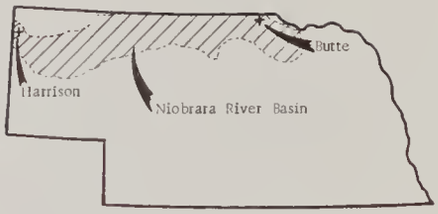
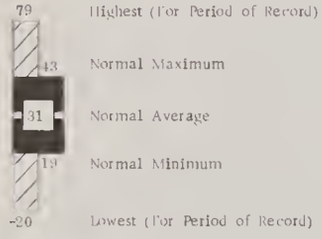


Figure II-2.--MONTHLY DISTRIBUTION OF PRECIPITATION, NIOBRARA RIVER BASIN, NEBRASKA





LOCATION OF HARRISON AND BUTTE IN THE BASIN



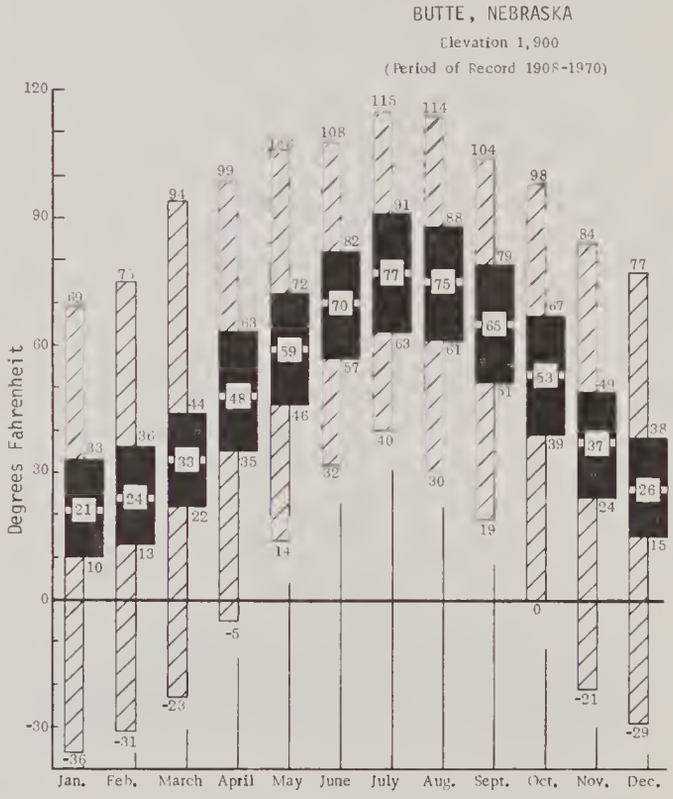


Figure II-3.--MONTHLY DISTRIBUTION OF TEMPERATURE, NIOBRARA RIVER BASIN, NEBRASKA

The average annual basin snowfall for the last twenty years has been 36 inches. This is slightly less than the long-term (over 50 years) average. The snowfall in Alliance is a noted exception in that the 20 year ('51-'70) average is 54 inches while the historic average (61 years of record) is approximately 41 inches. Many stations in the basin have recorded seasonal snowfalls over 60 inches. Alliance recorded over 88 inches during the winter of 1958-59 and over 80 inches during the 1969-70 winter season.

The average basin temperature (1931-1960) increases only slightly from 46°F at Harrison to 49°F at Butte. Large fluctuations in daily temperatures are common in spring and summer during thunderstorm activity. Normal monthly maximum, minimum, mean, and extreme temperatures at Harrison and Butte, Nebraska, are shown on Figure II-3.

Annual lake or reservoir evaporation ranges from approximately 38 inches at the eastern edge to 45 inches near the western edge of the basin in Nebraska. Table II-4 summarizes evaporation data from the three weather bureau stations within or near the basin. These data are gathered during the period May through September.

TABLE II-4.--EVAPORATION DATA
NIOBRARA RIVER BASIN, NEBRASKA

Station	Recorded Period of Record	Class A Pan Data 1/ Max. (Yr.)	Average	Min (Yr.)	Estimated Annual Lake or Reservoir
		----------Inches----------			
Box Butte Experimental Station, El. 4,020 ft.	1937 - 1970	56.6 (1956)	44	31.8 (1942)	45
Valentine Lakes & Game Refuge, El. 2,929 ft.	1948 - 1970	43.1 (1949)	38	34.0 (1962)	40
Gavins Point Dam, El. 1,255 ft.	1961 - 1970	46.4 (1968)	40	36.0 (1965)	38

Source: U.S. Weather Bureau, U.S. Department of Commerce.

1/ Data gathered May through September.

Alternate periods of drought and excess rainfall of varying severity have occurred a number of times during the past 40 years. Figure II-4 is a graphical illustration of both severity and duration of past moisture conditions.

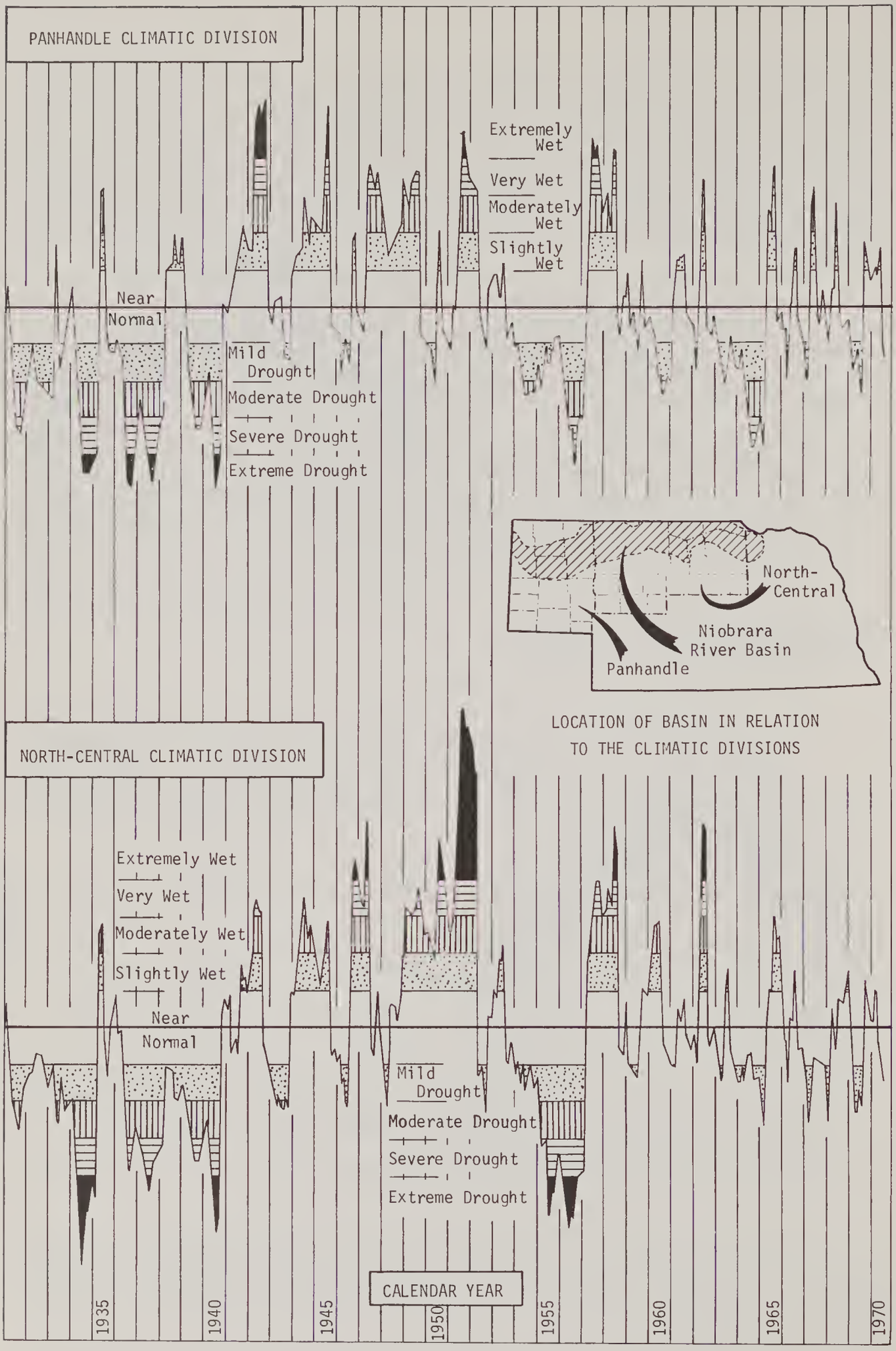


Figure II-4.--DROUGHT AND WET SPELL PERIODS FOR PANHANDLE AND NORTH-CENTRAL CLIMATIC DIVISIONS, NEBRASKA

Prevailing surface wind direction is northerly in the spring and fall, westerly in winter and southerly during the summer. Yearly average wind velocity is about 11 mph and velocities over 50 mph have occurred during every month of the year.

The frost-free period (32°F threshold) averages slightly over 120 days at the Nebraska-Wyoming stateline. The average increases to nearly 150 days at the lower, eastern edge of the basin. Average date of last spring frost is May 5 in the east and May 20 in the west. First 32°F or lower temperatures in the fall occur around September 20 in the west and September 30 in the east.

Tornadoes are not common in the basin. However, they do occur and have caused extensive damage. While hail storms are relatively frequent, damage is generally not widespread. Possible sunshine is estimated to be 64-67 percent on an average annual basis.

C. Physiography and Geology

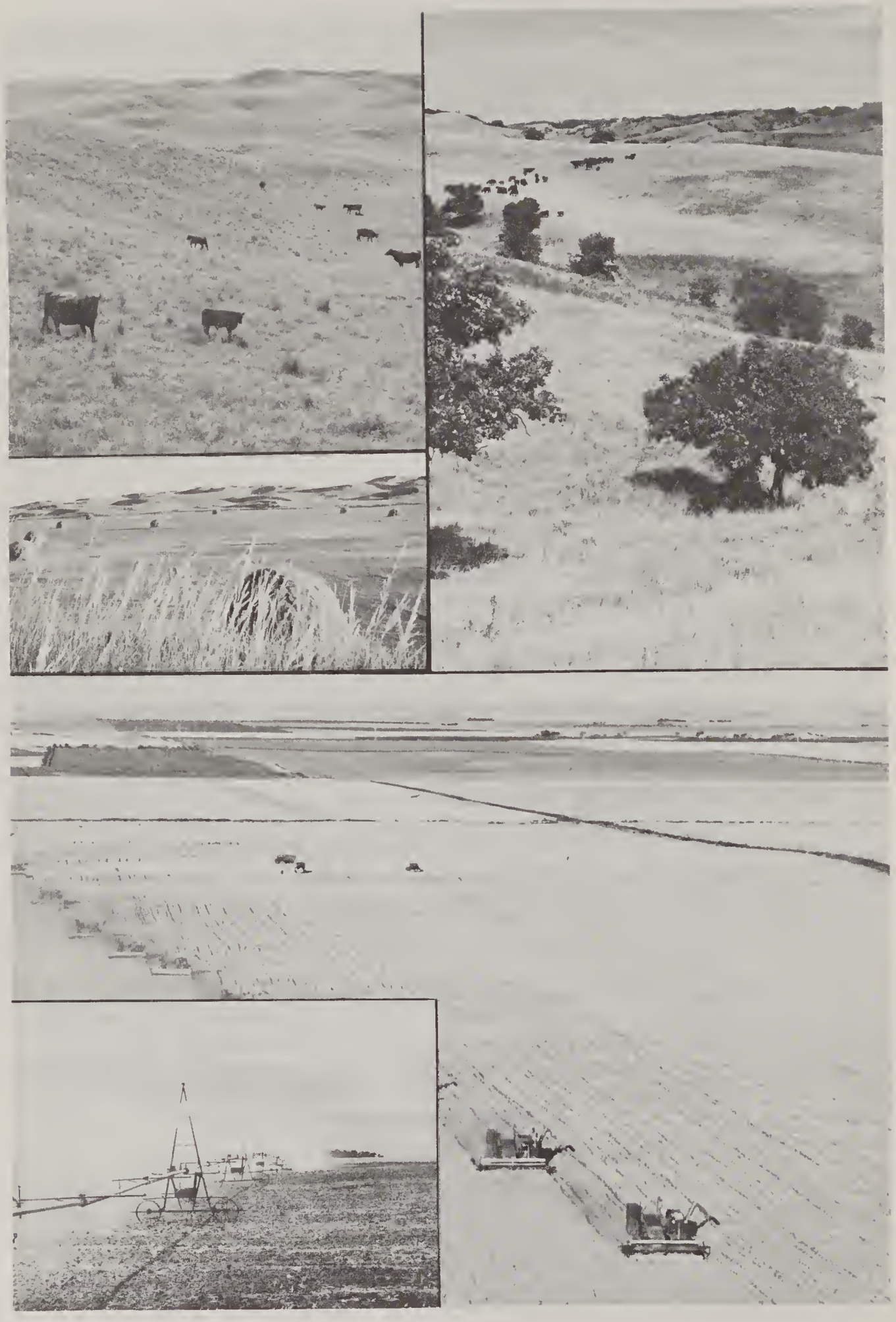
The Niobrara River Basin lies almost entirely in the High Plains section of the Great Plains physiographic province. The area north and east of the Keya Paha River, including the Ponca Creek drainage, lies within the unglaciated Missouri Plateau section.

The basin can be further subdivided into three distinct physiographic areas, determined to a large extent by the geological materials which underlie them. These are, from west to east: Wyoming-Colorado-Nebraska Tablelands: Sandhills: and Dakota-Nebraska Eroded Tablelands. Loess-Sandhills transition areas border these areas on the west and east.

In western Nebraska, the tablelands are part of the original High Plains surface which developed on the sandstones of the Hemingford and Arikaree groups. The Box Butte Table south of the Niobrara River and the Pine Ridge (or Dawes) Table on the north are the largest remnants. Generally, the surface of these tables is nearly level to gently rolling, becoming rough and broken along the Niobrara and its principal tributaries.

The Sandhills area comprises about 43 percent of the Nebraska portion of the basin, about 4,825 square miles. The surface is one of strongly rolling, grass-covered dunes of sand interspresed with flat-floored sandy valleys which often contain lakes or marshes. The dunes may range in height from 50 to as much as 300 feet. The Sandhills are derived principally from the reworking by wind of the somewhat softer sandstones of the Ogallala Formation.

The Dakota-Nebraska Eroded Tablelands commence in northeast Cherry County north of the Niobrara River with the Crookston Table which is joined on the east by the Springview Table. Eastward, the Naper Table is defined by the Keya Paha River on the west and Ponca Creek on the east. Most of the area drained by Ponca Creek is known as the Rolling Pierre Shale Plains. Tablelands south of the Niobrara River start with the



Ainsworth Table in central Brown County, and continue eastward with the Long Pine and Holt Tables.

The upland surface of most of these tables is nearly level to gently rolling. The continuity of the surface is broken at frequent intervals by deeply entrenched major tributaries, the largest undissected surface being only a few thousand acres. Sandstones of the Ogallala Formation underlie all of the Dakota-Nebraska Tablelands except for the Rolling Pierre Plains and Hills which are underlain by the Pierre Shale Formation.

In western Nebraska, meadowlands lie at elevations of five to 20 feet above the Niobrara River, and several large and extensive terraces are located 45 to 200 feet above the general river level. The largest terrace, Mirage Flats, occurs in Sheridan County, and another somewhat smaller one, Lavaca Flats, occurs in western Cherry County.

The relief of the basin varies from a maximum elevation of about 6,100 feet at a point about 10 miles southwest of Lusk, Wyoming to an elevation of about 1,220 feet at the junction of the Niobrara and Missouri Rivers near Niobrara, Nebraska. The Niobrara River enters Nebraska in Sioux County west of Harrison at an elevation of about 4,700 feet. From there the river falls at an average of nine feet per mile to its junction with the Missouri River.

Geologic materials in the Niobrara River Basin occur as unconsolidated deposits of Pleistocene (Quaternary) Age overlying semiconsolidated bedrock of Tertiary Age or consolidated bedrock of Cretaceous Age.

The stratigraphic position of the various geologic formations, their general description, and their water-bearing properties are listed in Table II-5. The distribution of the Tertiary and Cretaceous rocks within the basin is shown on the geologic map, Figure II-5.

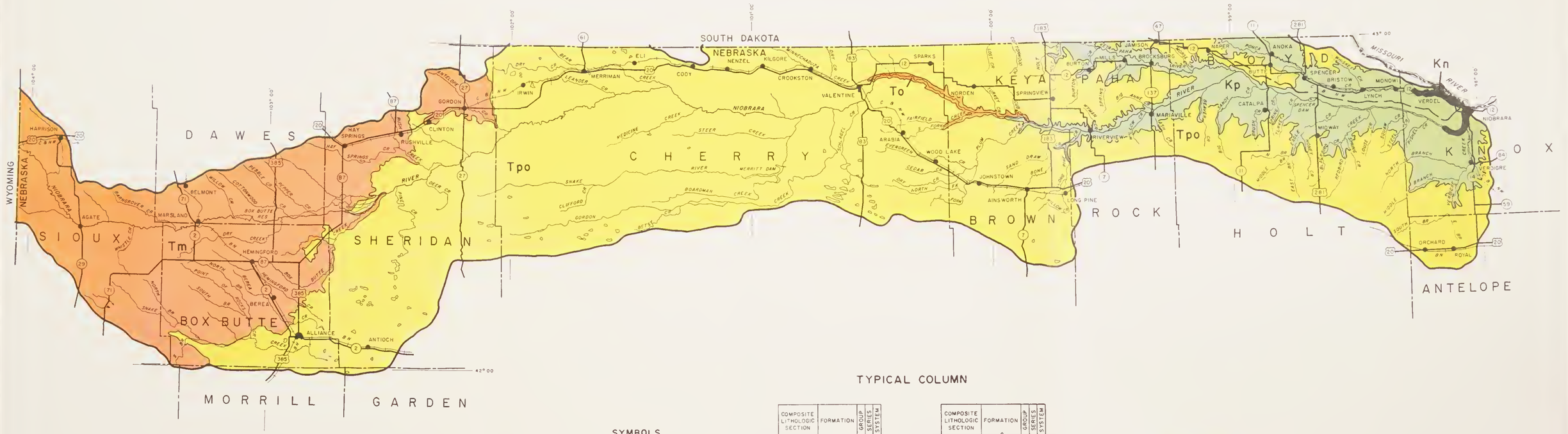
The unconsolidated materials of the uplands are principally windblown sands with some silts and clayey silts (loess). These overlie Tertiary bedrock in the west and central parts of the basin, and sand and gravel in the eastern part. Except for the Sandhills where the sand may attain a thickness of 300 feet, the upland sediments are relatively thin over the bedrock. In local areas, as on the Ainsworth Table, the underlying sand and gravel and associated sediments may range up to 175 feet in thickness.

Along the Niobrara and principal tributaries, alluvial sediments consist of sand and fine gravel in the flood plains, with somewhat finer textured materials in the adjoining terraces and flats. These sediments have a maximum thickness of about 25 feet.

In its traverse from west to east, the Niobrara River cuts successively through the predominantly sandstone bedrock of the Arikaree, Hemingford, and Ogallala groups, reaching siltstone of the White River group near Valentine. Near the 100th meridian in Keya Paha County, the

Table II-5.--GEOLOGIC FORMATIONS AND THEIR WATER-BEARING PROPERTIES
NIOBRARA RIVER BASIN

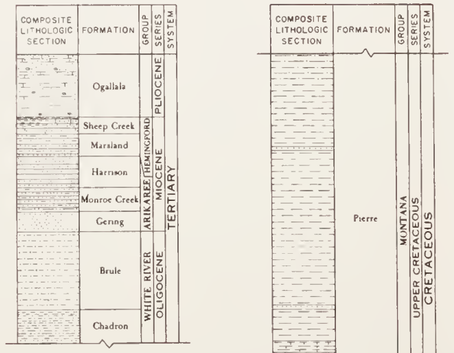
System	Series	Stratigraphic Unit	Thickness (feet)	Texture and Areal Distribution	Water Supply
QUATERNARY	RECENT	Surficial alluvium and colluvium, eolian silts and sands and soil.	0-20	Reworked silt, clay and sand in floodplains and terraces bordering stream channels; eolian silt and sand on slopes and upland: dune sand related to blowouts which are extensive in Cherry Co., central Sheridan Co., and southern Brown Co.	Generally above water table; significant primarily as transmitting medium for recharge to the ground water reservoir.
	LATE PLEISTOCENE	Dune sand, alluvial sands, eolian silts.	0-300	Dunes of fine and very fine sand in Sandhills and adjacent upland areas; stream-deposited sands beneath floodplains and in higher terraces; loess of the Peoria formation principally in the eastern uplands.	Dune sand generally above water table but yields water readily to wells where saturated; an important medium for transmitting recharge to the zone of saturation. Alluvial sediments yield small to moderate supplies where a sufficient thickness is saturated. Peoria loess significant only as a transmitting medium for recharge to the ground water reservoir.
	EARLY PLEISTOCENE	Gravel, sand, silt and clay.	0-175	Generally finer sands and gravels and thinner in the western part of the basin becoming thicker and more coarse in the east; locally may contain silt and clay to 25 feet thick; underlies major stream valleys and terraces principally south of Niobrara River.	Generally yields water readily to wells with supplies adequate for irrigation where thick deposits are saturated; silts and clays not a source of water supply.
TERTIARY	PLIOCENE	Ogallala formation.	0-600	Fine to coarse sand, sandstone, sandy gravel and silt; some beds are cemented and hard; locally contains thin beds of volcanic ash. Extensively exposed along the Niobrara River and major tributaries in all but Sioux and Dawes Counties; underlies the upland in most of the basin.	Yields water readily to wells; where fine-textured, 100 to 200 feet of saturated material must be penetrated to obtain large volume wells.
	MIOCENE	Hemingford Group	0-500	Predominantly very fine sandstone to siltstone of the Marsland formation, overlain locally by silty and sandy clays. Exposed in Sioux, Dawes, Box Butte and Sheridan Counties, but absent in counties to the east.	The Marsland formation furnishes small supplies of water but generally lies above the water table in much of the area.
		Arikaree Group	0-500	Medium to fine-grained sandstone of the Harrison formation overlies very fine-grained sandstone of the Monroe Creek formation; concretions are common in both formations. Underlain locally by fine to coarse sand of the Gering formation. Exposed along the Niobrara in Sioux, Dawes and Box Butte Counties, and in scattered upland localities in Sheridan County.	Where sufficient thickness of saturated material is penetrated, the Harrison formation yields large amounts of water and the Monroe Creek-Gering formations moderate amounts of water. These formations are important sources of water in the western part of the basin, especially in Box Butte County.
	OLIGOCENE	White River Group	0-700	Siltstone and sandy siltstone of the Brule formation underlies the central and western parts of the basin; it is exposed along the Niobrara River from near Valentine in Cherry County to south of Springview in Keya Paha County. The underlying Chadron formation consists of silty clay with local channels of sand and gravel.	Rocks of the White River Group are generally not considered as a source of water supply in the basin.
CRETACEOUS	UPPER CRETACEOUS	Pierre Shale	0-1000	Gray to black clayey shale containing thin layers of bentonite, limestone and shaly chalk. Underlies all of basin except for the lower end in the extreme eastern part. Extensively exposed in Knox, Boyd and Holt Counties and along the Keya Paha and Niobrara Rivers to near the 100th meridian.	Not a known source of water supply.
		Niobrara formation	200-275	Yellow and gray chalk, chalky shale and chalky limestone. Underlies all of basin but only exposed along Ponca Creek and Niobrara River in Knox County.	Not a known source of water supply.
		Carlile Shale	200	Shale and chalky shale. Underlies entire basin.	Not a known source of water supply.
		Greenhorn Limestone	25-30	Thin-bedded limestone and calcareous shale. Underlies entire basin.	Not a known source of water supply.
		Graneros Shale	65-200	Shale with thin beds of limestone and sandy shale. Underlies entire basin.	Not a known source of water supply.
	LOWER CRETACEOUS	Oakota Sandstone	350-700	Sandstone interbedded with clayey and sandy shale. Underlies entire basin.	The Dakota formation is an important source of domestic and stock water in the eastern part of the basin, yielding small to moderate amounts of moderately to highly mineralized water. The water is under artesian pressure and may flow at the surface in topographically low areas.



SYMBOLS

- SILT OR CLAY
- SHALE (GREEN OR GRAY)
- SAND OR SANDSTONE
- GRAVEL
- CHALK
- LIMESTONE

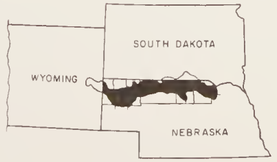
TYPICAL COLUMN



LEGEND

- Tpo OGALLALA FORMATION
- Tm HEMINGFORD-ARIKAREE GROUP
- To WHITE RIVER GROUP
- Kp PIERRE FORMATION
- Kn NIOBRARA

N



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LAMBERT CONFORMAL CONIC PROJECTION

SOURCE
SCS DRAWING 5,S-28978 AND GEOLOGIC BEDROCK MAP OF NEBRASKA PREPARED BY THE CONSERVATION AND SURVEY DIVISION, UNIVERSITY OF NEBRASKA(1969)

USDA-SCS-LINCOLN, NEBR. 1972

FIGURE II-5

GEOLOGIC BEDROCK MAP

NIOBRARA RIVER BASIN

NEBRASKA

3-31-72
5,S-30068

top of the Pierre shale formation of Cretaceous Age is reached, and eastward the river cuts through the entire thickness of the Pierre shale, reaching the Niobrara chalk formation about nine miles above the mouth of the Missouri River.

The Niobrara formation is the oldest rock exposed in the basin. It and the Pierre formation dip gently southwestward, rising locally over the northern extension of the Cambridge Arch in west-central Cherry County, and dipping westward again in Sheridan County. The overlying rocks of the Tertiary system generally dip at a low angle to the east.

Exposures of bedrock occur in every county, especially along the Niobrara River and its larger tributaries. Upland exposures are common in the western and eastern parts of the basin, but scarce in the Sandhills where the cover is much thicker.

The principal mineral resource of the basin is sand and gravel, with production mostly from the eastern counties. Some shale was formerly quarried for brick manufacture and local quartzite beds in the Ogallala formation were used for riprap. Potash obtained from the alkali lakes near Antioch was an important resource during World War I. Some exploratory drilling for petroleum has been done -- mostly in Sioux, Dawes and Sheridan Counties -- but there are no producing wells in the basin.

D. Land Resources

The USDA has developed a major land classification system that has divided the United States into Land Resource Regions which are further divided into Land Resource Areas (LRA's). These LRA's have significant characteristics of topography, soils, elevation, and precipitation with contrasts between land resource areas usually distinct and in some cases, very abrupt.

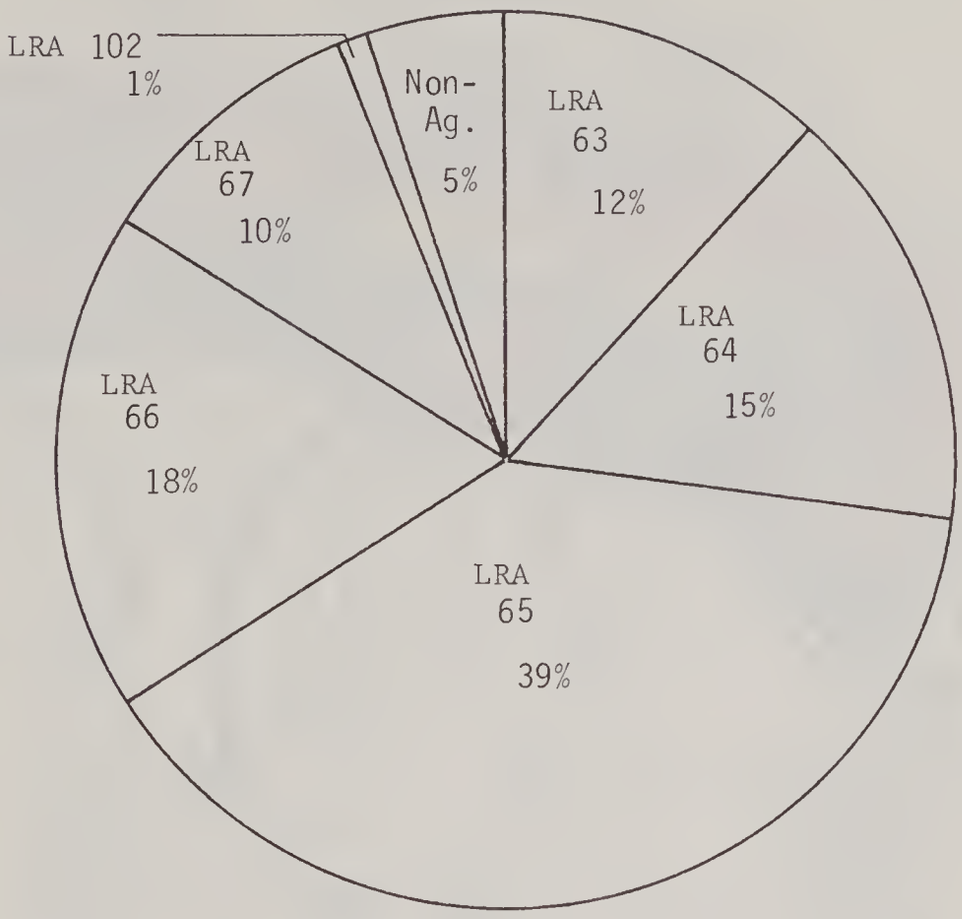
The Niobrara River Basin is located in the Western Great Plains Range and Irrigated Region. Portions of six Land Resource Areas lie within the Niobrara Basin. The LRA's differ in climate, elevation and topography, land use, and soils (see Table II-6, and Figures II-6 and II-7). Within each Land Resource Area, the major differences are those associated with the existing soil resources. These soil resources have been grouped into soil associations whose locations are shown on the general soil map (Figure II-8). A description for each association is as follows:

Table II-6.--DESCRIPTION OF LAND RESOURCE AREAS, NIOBRARA BASIN 1/

Land Use	Elevation and Topography	Water	Climate
	67 - Central High Plains		
Most of area is in farms and ranches. About 3/4 of the area is in native range and about 1/5 of the land is dry-formed. Winter wheat is the main cash crop.	1,800 to 3,000 feet, rising gradually from east to west. Ridgetops on dissected shale and clay pan are undulating and relatively narrow. Steep walled valleys have very narrow floodplains.	Area depends almost entirely on relatively low and somewhat erratic rainfall. Ground water is scarce and of poor quality.	Average annual precipitation is 14 to 18 inches. Average freeze-free period - 140 to 150 days.
	64 - Mixed Sandy and Silty Tableland		
Nearly all of the land is in farms and ranches. About half of the area is in native grass and nearly 1/3 is cropland.	3,000 to 4,000 feet, increasing gradually from east to west. The level to gently sloping tableland is cut by narrow steep-walled valleys. Along the southern edge deep sands have irregular rolling to hilly dune topography.	Most of the area depends on rather low and erratic rainfall. Generally ground water is scarce and of poor quality in most of the area.	Average annual precipitation is from 16 inches to 20 inches. The average freeze-free period is about 140 to 160 days.
	65 - Nebraska Sandhills		
Nearly all the land is in large ranches and most of it is in native grass grazed by livestock. Small areas along streams are used to grow hay and other feed crops.	2,000 to 4,000 feet, rising gradually from east to west. Most of the area consists of stabilized sand dunes. There are many scattered small level depressions. Streams are few but there are many small lakes and marshes in deeper depressions.	Rangeland depends on rainfall for water. Many small lakes and ponds provide water for livestock. Ground water is abundant and of good quality.	Average annual precipitation is from 16 to 20 inches. Average freeze-free period is from 140 to 160 days.
	66 - Dakota-Nebraska Eroded Tableland		
Nearly all the land is in farms and ranches and more than 3/4 of it is in native range. Between 10 and 20 percent of the area is cropland. Some wheat is grown for cash sale. Forage and feed grains are the major crops.	2,000 to 3,000 feet, increasing from east to west. These undulating to rolling uplands are underlain by calcareous sandstones. Steep slopes border valleys of most streams.	Crops and range depend mainly on rainfall for water. Ground water is scarce and of poor quality except along the southern fringe where wind-blown sands yield an abundance of ground water existing at shallow depths.	18 to 24 inches of precipitation annually. Average frost-free growing season is from 140 to 160 days.
	63 - Rolling Pierre Shale Plains		
Most of the area is in farms and ranches. About 3/4 of the area is in native range and about 1/5 of the land is dry farmed. Winter wheat is the main cash crop.	1,800 to 3,000 feet, rising gradually from east to west. Ridgetops on dissected shale and clay pan are undulating and relatively narrow; side slopes are hilly to steep. The steep walled valleys have	The area depends almost entirely on relatively low and erratic rainfall. The few perennial streams have very wide seasonal fluctuations in flow. Ground water is scarce and of poor quality.	Average annual precipitation is from 20 to 24 inches. The average frost free season is from 140 to 160 days.
	102 - Loess, Till, and Sandy Prairies		
Almost all of the area is in farms, and about 70 percent of it is cropland. About 1/5 of the area is in pasture and range. Major cash crops are corn, wheat, and other small grains.	1,000 to 2,000 feet. A nearly level to rolling plain mantled by loess. Slopes are gentle except in areas bordering some stream valleys.	Crops and pasture depend on moderate rainfall. Year to year fluctuations are large and crop yields are seriously reduced in dry years. Shallow wells in glacial deposit are principal source of water for domestic and livestock needs.	Average annual precipitation is from 20 to 24 inches. Average frost free season is 140 to 160 days.

1/ Reference -- Land Resource Regions and Major Land Resource Areas of the U.S. -- Agr. Handbook #296 -- SCS, USDA.

Figure II-6.--DISTRIBUTION OF LAND BY LAND RESOURCE AREA
NIOBRARA RIVER BASIN, NEBRASKA



Keith - Rosebud association: Deep and moderately deep, loamy and silty moderately permeable soils formed in loess, and calcareous sandstone.

This association consists of gently rolling plains and slopes from the top of tablelands to streams. Small isolated buttes with level tops rise 20 to 50 feet above the plain in places.

The deep Keith soils have a silt loam surface layer and subsoil. Rosebud soils are moderately deep. They have a loam surface layer and clay loam subsoil underlain by sandstone at a depth of about 30 inches. There are some areas underlain by sand and gravel and some steep drainageways where rock outcrops are common.

This soil association is cultivated and used for native grasses. The more sloping areas are commonly in native grasses. Wheat is the principal crop. Much of the wheat is summer fallowed. Soil blowing is a hazard and the sloping soils are subject to water erosion.

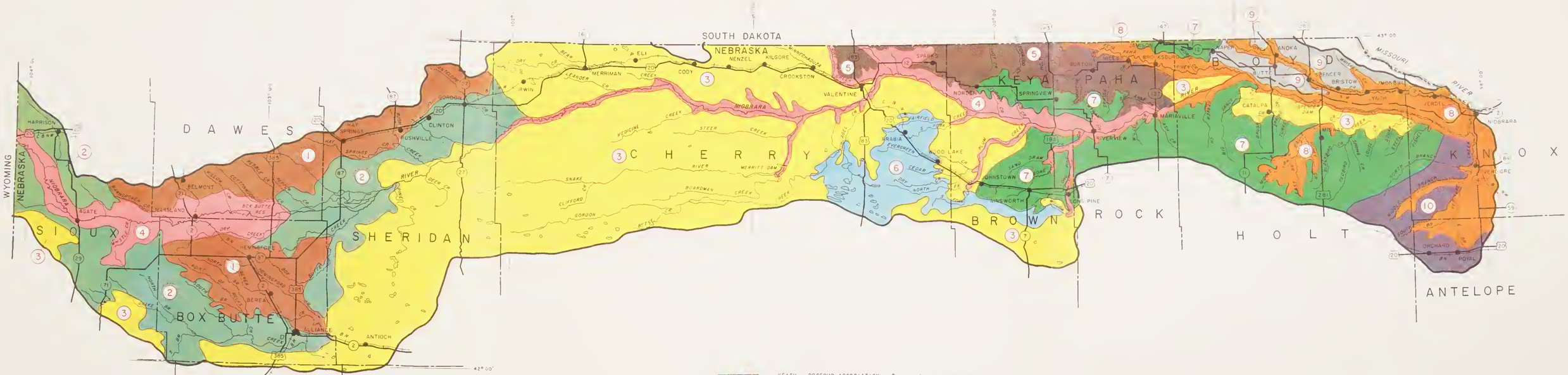
FIGURE II-7 MAJOR LAND RESOURCE AREAS FOR NEBRASKA

LEGEND

60 PIERRE SHALE PLAINS AND BADLANDS
63 ROLLING PIERRE SHALE PLAINS
64 MIXED SANDY AND SILTY TABLELAND
65 NEBRASKA SANDHILLS
66 DAKOTA-NEBRASKA ERODED TABLELAND
67 CENTRAL HIGH PLAINS
71 CENTRAL NEBRASKA LOESS HILLS
72 CENTRAL HIGH TABLELAND
73 ROLLING PLAINS AND BREAKS
75 CENTRAL LOESS PLAINS
102 LOESS, TILL, AND SANDY PRAIRIES
106 NEBRASKA AND KANSAS LOESS-DRIFT HILLS
107 IOWA AND MISSOURI DEEP LOESS HILLS

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



1 KEITH - ROSEBUD ASSOCIATION. Deep and moderately deep, loamy and silty, moderately permeable soils formed in loess, and calcareous sandstone.

2 JAYEM - KEITH - TASSEL ASSOCIATION. Deep to shallow, loamy and silty, rapidly to moderately permeable soils formed in eolian sands, loess and sandstone.

3 VALENTINE - OUNOAY ASSOCIATION. Deep, sandy, rapidly permeable soils formed in eolian sands.

4 ROUGH - BROKEN LAND ASSOCIATION. Rough broken land, steep soils with rock outcrops and shallow soils.

5 ANSELMO - VALENTINE ASSOCIATION. Deep, loamy and sandy, moderately rapid to rapidly permeable soils formed in eolian sands.

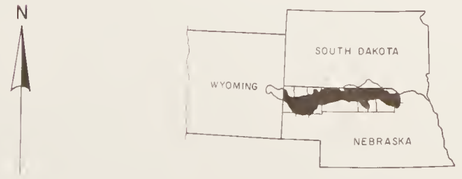
6 ELSMERE - GANNETT - VALENTINE ASSOCIATION. Deep, sandy and loamy, moderately rapid to rapidly permeable soils formed in eolian sands and water reworked sands and silt.

7 JANSEN - THURMAN - MEADIN ASSOCIATION. Deep, sandy, rapidly permeable soils and moderately deep to shallow, loamy, moderate to very rapidly permeable soils over sand and gravel.

8 BOYD - LAKOMA ASSOCIATION. Moderately deep, clayey, slow to very slowly permeable soils formed in clays and shales.

9 RELIANCE - ORTELLO ASSOCIATION. Deep, silty and loamy, moderate to moderately rapid permeable soils formed in loess and eolian sands.

10 THURMAN - ORTELLO ASSOCIATION. Deep, sandy and loamy, rapidly and moderately rapid permeable soils formed in eolian sands.



SCALE 10 0 10 20 30 40 MILES

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SOURCE
SCS DRAWING 5,S-28978 AND INFORMATION FROM SCS FIELD TECHNICIANS

LAMBERT CONFORMAL CONIC PROJECTION

USDA-SCS-LINCOLN, NEBR. 1972

FIGURE II-8

GENERAL SOIL MAP

NIOBRARA RIVER BASIN

NEBRASKA

3-30-72
5,S-30067

Jayem - Keith - Tassel association: Deep to shallow, loamy and silty, rapidly to moderately permeable soils formed in eolian sands, loess and sandstone.

This association consists of transition areas of soils with fine sandy loams and silt loam textures. There has been much mixing and sorting of the materials by wind. Usually the landscape is hummocky or undulating.

Jayem soils have a fine sandy loam surface layer and subsoil. Keith soils have a fine sandy loam surface layer and subsoil. The shallow Tassel soils have about 10 to 20 inches of fine sandy loam over sandstone. Jayem soils have moderately rapid permeability, Keith soils have moderate permeability, and Tassel soils have moderately rapid permeability. Small areas having bedrock near the surface on uplands and small areas of bottomland soils are present.

The less sloping areas are commonly used for cultivated crops such as wheat and sorghum. The more sloping areas are used for grazing. Soil blowing is a hazard.

Valentine - Dunday association: Deep, sandy, rapidly permeable soils formed in eolian sands.

This association is in the Sandhills area of Nebraska. The landscape is a succession of dunes and swales with some narrow elongated dry valleys, scattered shallow lakes and infrequent streams.

Valentine and Dunday soils have a loamy fine sand or fine sand surface layers and underlying material. Valentine soils have a thin dark colored surface layer. Dunday soils usually are less sloping and have a thicker darker colored surface layer. Some poorly drained and somewhat poorly drained soils are along the stream valleys. Valentine and Dailey soils are dominant in the western part of the association.

Nearly all of the association is used for rangeland and hayland. Controlling soil blowing is the main management concern.

Rough-Broken Land association: Rough broken land, steep soils with rock outcrops and shallow soils.

This association consists of rough broken land and escarpments along the Niobrara River. The rock outcrops are on steep and in places, nearly vertical slopes. There are numerous ridges, buttes and canyons. In most areas the Niobrara River flows through this association.

Canyon and Tassel soils are on the less sloping, commonly higher landscape position. They have 10 to 20 inches of loamy material over sandstone. Canyon soils are in the eastern part of the association while Tassel soils are in the western part.

Rangeland is the dominant use made of this soil association. A few pine and cedar trees occur in many areas. This association is among the most scenic areas of Nebraska.

Anselmo - Valentine association: Deep, loamy and sandy, moderately rapid to rapidly permeable soils formed in eolian sands.

This association consists of an undulating to hummocky plain. The valley sides along the major streams are steep with slopes broken by frequent outcrops of sandstone bedrock.

Anselmo soils have fine sandy loam surface layers and subsoils. They have moderately rapid permeability. Valentine soils have a fine sand surface layer and underlying material. They have rapid permeability. Holt and Canyon soils are less extensive soils formed in sandstone.

Most of this association is in native grass and used for grazing. Wheat, corn and forage sorghum are cultivated crops. The main concerns are the conservation of moisture, soil blowing and control of water erosion.

Elsmere - Gannett - Valentine association: Deep, sandy and loamy, moderately rapid to rapidly permeable soils formed in eolian sands and water reworked sands and silt.

This association consists of undulating areas of somewhat poorly to very poorly drained soils with rolling higher areas of excessively drained soils.

Elsmere soils have loamy fine sand surface layers and fine sand underlying material. Elsmere soils are somewhat poorly drained. Gannett soils are poorly to very poorly drained. They have fine sandy loam surface layers over fine sand. The excessively drained Valentine soils have fine sand surface layers and underlying material.

Much of this association is in native grass and is used for hayland. The high water table in many areas severely limits the growing of cultivated crops.

Jansen - Thurman - Meadin association: Deep, sandy, rapidly permeable soils and moderately deep to shallow, loamy, moderate to very rapidly permeable soils over sand and gravel.

This association consist of an undulating plain which has been incised at infrequent intervals by canyon-like drainage-ways. Part of the area is a series of old high terraces which are covered by sandy or gravelly waterlaid sediments resting on bedrock.

Jansen soils have a silt loam surface layer and a clay loam subsoil underlain by coarse sand and gravel at a depth of about 30 inches. Thurman soils have loamy fine sand surface layers and underlying material.

Meadlin soils have about 18 inches of sandy loam material over sand and gravel. Thurman soils are rapidly permeable. Jansen soils are moderately permeable in the upper part and very rapid in the sand and gravel. Meadlin soils have rapid permeability in the upper part and very rapid in the lower part.

This association is used for cultivated crops and grassland. Due to the droughty nature of the soils, cultivated crops are grown with varying success under dryland management. Irrigation development has increased in recent years.

Boyd - Lakoma association: Moderately deep, clayey, slow to very slowly permeable soils formed in clays and shales.

This association area has been deeply dissected by the Niobrara River and its tributaries. The divides between the drainageways are gently sloping and the valley sides are steep.

Boyd and Lakoma soils have clay or silty clay surface layers and subsoils over shale at about 20 to 40 inches. Boyd soils are dark colored while Lakoma soils are light colored. Some less sloping divides are silty soils formed in loess.

Most of this association is in native grass and used for grazing. A few of the less sloping areas are used for cultivated crops or hayland. These soils have a severe water erosion hazard.

Reliance - Ortello association: Deep, silty and loamy, moderate to moderately rapid permeable soils formed in loess and eolian sands.

This association consists of broad gently undulating eidges and sideslopes that form the divides between major streams. Much of the area has a thin cap of loess.

The Reliance soils have a silt loam surface layer, a silty clay loam subsoil and the underlying material is a silty clay loam. In some places the underlying material is a loam or sand. Ortello soils have fine sandy loam surface layers and subsoils. They are underlain by a loamy fine sand or fine sand at a depth of 24 inches. Reliance soils have moderate permeability and Ortello soils have moderately rapid permeability.

Most of this association is cultivated. The steeper areas are in rangeland. Controlling erosion and maintaining soil fertility are the main concerns in managing cultivated areas.

Thurman - Ortello association: Deep, sandy and loamy, rapidly and moderately rapid permeable soils formed in eolian sands.

This association consists of mixed sandy and loamy soils in a complex pattern. The landscape is nearly level to strongly sloping. The

area is between the sandhills to the west and soils formed in loess to the east.

Thurman soils have loamy fine sand surface layers and underlying material. Ortello soils have fine sandy loam surface layers and subsoils. They are underlain by a loamy fine sand or fine sand at a depth of 24 inches. Thurman soils are rapidly permeable and Ortello soils are moderately rapidly permeable. Some poorly drained soils occur in some valleys.

Corn, spring small grains, and alfalfa are the principal cultivated crops. Many areas are in native grasses. These soils have a severe soil blowing hazard. Many shelterbelt plantings have been established in this formerly treeless grassland area.

Within each of the soils associations there is an additional classification of the soil resource. This is a capability classification which is a practical method of grouping soils for use, treatment, and management.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or to esthetic purposes.

The above capability classes are further divided into subclasses that show the principal kinds of problems involved. The subclasses are:

erosion as indicated by e, such as IIIe; wetness indicated by w, such as Vw; soil limitations (shallowness or droughtiness) indicated by s, such as IVs; and climatic limitations indicated by c, such as IIc.

Table II-7 shows the present major land use by Land Capability Classes in the Niobrara River Basin. Only about one and one quarter percent of the soils are in Class I. They are suited for a wide range of plants and can be safely cultivated by following good soil management practices. When Class I soils are irrigated with gravity systems, some land leveling and reshaping of the surface may be necessary in order to obtain more uniform application of water. About 5,800 acres of Class I land are used for pasture and range, and unless it occurs in small areas or in locations not practical to cultivate, much of this land could be used for cropland.

TABLE II-7.--PRESENT MAJOR LAND USE BY LAND CAPABILITY CLASSES
NIOBRARA RIVER BASIN, NEBRASKA

Land Capability Class	Cropland	Pasture & Range	Forest Land	Other	Total Ag. Land	Non-Agri.	Total
	(Acres)						
I	85,710	5,790	0	0	91,500		
II	536,400	308,560	9,700	11,720	866,380		
III	424,180	698,850	21,120	10,900	1,155,050		
IV	214,410	726,270	1,920	6,170	948,770		
V	1,080	43,920	5,030	210	50,240		
VI	75,470	2,722,240	59,250	7,880	2,864,840		
VII	-	1,068,850	18,250	0	1,087,100		
VIII	-	9,410	3,940	12,650	26,000		
TOTAL	1,337,250	5,583,890	119,210	49,530	7,089,880	354,720	7,444,600
	(Percent)						
I	1.16	0.07	-	-	1.23		
II	7.20	4.14	0.13	0.16	11.63		
III	5.70	9.39	0.28	0.15	15.52		
IV	2.88	9.76	0.02	0.08	12.74		
V	0.01	0.58	0.07	T	.66		
VI	1.01	36.58	.80	.11	38.50		
VII	-	14.36	0.25	-	14.61		
VIII	-	0.13	0.05	0.17	.35		
TOTAL	17.96	75.01	1.60	0.67	95.24	4.76	100

About 12 percent of the soils in the basin are in Land Capability

Class II. When cultivated, Class II lands need a conservation cropping system with minimum tillage and crop residue management to improve and maintain the soil in good physical condition. Class II lands can be used for pasture and range, woodland, or wildlife habitat, if proper use and good management practices are followed. Presently, about 318,000 acres of Class II land are used for pasture and forest land. Most of this land is suitable for the production of cultivated crops.

About 15 percent of the soils in the basin are Class III. Water erosion is the major hazard. Conservation cropping systems with minimum tillage, crop residue management, contour farming, terraces, and grassed waterways are needed if these lands are cultivated. Alternate uses of Class III lands are pasture and range, forest land, and wildlife habitat. Over 698,000 acres of Class III land are used for pasture and rangeland. Much of this land is suitable for cropland. Proper use of pastures and good management and adequate fire protection of woodland and wildlife areas are required to maintain sufficient cover to control erosion and runoff.

About 13 percent of the soils in the basin are in Land Capability Class IV. Water erosion is the major hazard. Most of the lands in Class IV are sloping with various degrees of erosion. The number of years that Class IV soils are continuously cultivated must be limited. The cropping systems required consist of mostly close-drilled crops with stubble mulch tillage operations that will leave sufficient crop residue on the surface. Pasture, forest land, and wildlife habitat are more desirable uses of these lands. Over 214,000 acres of Class IV land are used for cultivated crops.

There are only about 50,300 acres of soils in Land Capability Class V. Most of the Class V lands in the basin have a high water table and are used for forestry, pasture, and range.

About 38 percent of the agricultural land in the basin is in Land Capability Class VI. These soils are generally unsuited for cultivation. Most of the Class VI lands are on the steep slopes bordering the bottomlands. They contribute large amounts of sediment to floodplains and to stream channels. These steep areas should be used for pasture or planted to trees and shrubs which, under proper management, will provide a permanent cover and materially reduce runoff and soil erosion. Almost 75,000 acres are being cropped and should be converted to permanent cover.

Class VII lands occupy over 14 percent of the basin. These lands are unsuited to cultivation. Their use is largely restricted to pasture, range, or wildlife habitat. Proper use and careful management are necessary for adequate treatment.

Class VIII soils constitute less than one-half percent of the total agricultural land of the basin. These soils are not suited to agricultural production, but do have value for forestry, wildlife, and recreation.

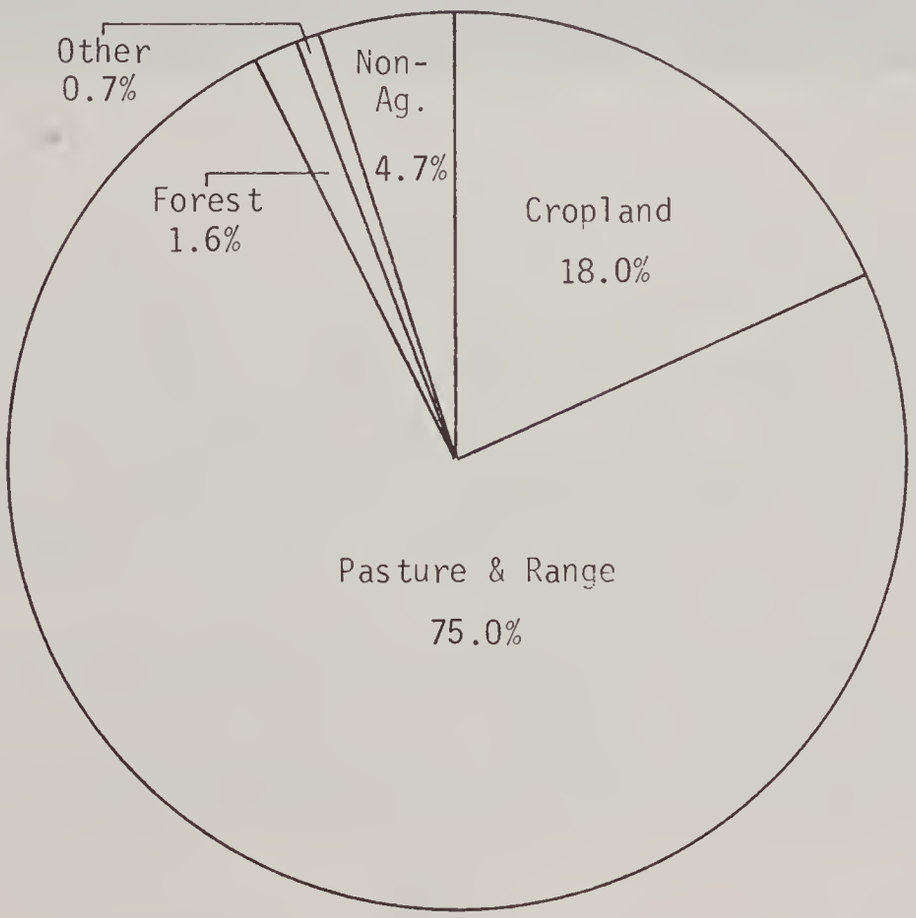
Over 95 percent of the area in the basin is used for agricultural purposes. Of the total land, 18 percent is cropland; 75 percent is pasture, range, and native hay; and 1.6 percent is forest land. The balance of the basin consists of farmsteads, idle land, wildlife areas, water, and miscellaneous areas not otherwise classified (see Figure II-9).

Over 1,337,000 acres of cropland exist in the basin. The principal crops grown in the basin are corn, grain sorghum, winter wheat and alfalfa hay. Minor acreages of oats and soybeans are also grown.

Most of the acres in pasture and range are classified as rangeland. Rangeland is land used for grazing livestock, and on which the climax (natural potential) plant community is dominated by grasses. Most of the small grassed areas, near farmsteads, are in introduced grasses, and are usually minor parts of a general farming enterprise and therefore fields are smaller than where grazing is the predominate land use. About 119,000 acres is forest and woodland.

About 80 percent of the basin's forested area is classed as understocked woodland. Also included in the forest land acreage are about 1,000 acres of shelterbelts (width of over 120 feet and a minimum area of one acre). In addition to species of trees native to the basin, shelterbelts include introduced species such as Russian olive, Russian mulberry, Siberian elm, ponderosa pine, and Austrian pine.

FIGURE II-9.--DISTRIBUTION OF LAND BY MAJOR USE
NIOBRARA RIVER BASIN, NEBRASKA



E. Native Plant Communities

The native plant communities associated with the Niobrara River Basin are unique and different. They will vary in kinds, amounts and production of plants depending upon their position on the landscape, soil texture, soil depth, and watertable. There are six distinct types, namely Wetlands, Sandylands, Hardlands, Shallowlands, Savannah, and Forestlands.

Wetlands

The original plant community is a mixture of such decreaser grasses as prairie cordgrass (Spartina pectinata), big bluestem (Andropogon gerardi), little bluestem (Andropogon scoparius), indiangrass (Sorghastrum nutans), switchgrass (Panicum virgatum), and Canada wildrye (Elymus canadensis) making up at least 70 percent of the total plant volume with other perennial grasses, forbs and shrubs accounting for the remainder. Kentucky bluegrass (Poa pratensis), green muhly (Muhlenbergia racemosa), western wheatgrass (Agropoyron smithii), and various sedges (Carex spp.), rushes (Juncua spp.), and bulrushes (Scirpus spp.), are the principal increasers. When the plant community is in excellent range condition, the total annual production ranges along the Niobrara River from a low of 4000 pounds per acre, air-dry, in unfavorable years to a high of 5500 pounds in favorable years.

This plant type is found on soils which vary from loamy fine sand to silt loam and have a watertable within 5 feet of the soil surface.

Sandylands

The original plant community is a mixture of such decreaser plants as sand bluestem (Andropogon hallii), little bluestem, switchgrass, prairie junegrass (Koeleria cristata), sand lovegrass (Eragrostis trichodes), and leadplant (Amorpha canescens) making up at least 50 percent of the total plant volume with other perennial grasses, forbs, and shrubs accounting for the remainder. Prairie sandreed (Calamovilfa longifolia), needleandthread (Stipa comata), blue grama (Bouteloua gracilis), hairy grama (Bouteloua hirsuta), Scribner panicum (Panicum scribnerianum), sand dropseed (Sporobolus crystandrus), sand paspalum (Paspalum stramineum), cudweed sagewort (Artemisia graphalodes), fringed sagewort (Artemesia frigida), brittle pricklypear (Opuntia fragilis), and small soapweed (Yucca glauca) are the principal increasers. When the plant community is in excellent range condition, the total annual production in the Panhandle area will range from a low of 1250 pounds per acre, air-dry, in unfavorable years to a high of 2500 pounds in favorable years. In the northcentral area, it will range from 1500 to to 3000 pounds. This plant type is found on soils that range from a fine sandy loam to fine sand.

Hardlands

The original plant community is a mixture of such decreaser grasses as big bluestem, little bluestem, sideoats grama (Bouteloua curtipendula), western wheatgrass, prairie junegrass and green needlegrass

(Stipa viridula), making up at least 50 perent of the total plant volume with other perennial grasses, forbs, and shrubs accounting for the remainder. Blue grama, buffalograss (Buchloe dactyloides), threadleaf sedge (Carex filifolia), needleandthread, Arkansas rose (Rosa arkansana), dotted gayfeather (Liatris punctata), false boneset (Kuhnia eupatorioides), heath aster (Aster ericoides), skeletonplant (Lygodesmia juncea), Sandberg bluegrass (Poa secunda), scarlet globemallow (Sphaeralcea coccinea), and slimflower scurfpea (Psoralea tenuiflora) are the principal increasers. When the plant community is in excellent range condition, the total annual production in the Panhandle area will range from 750 pounds per acre, air-dry, in unfavorable years to a high of 2500 pounds in favorable years. In the northcentral area, it will range from 1250 to 3000 pounds.

The soils where this plant type is found range in texture from silt loam to silty clay and may be calcareous.

Shallowlands

The original plant community is a mixture of such decreaser grasses as sideoats grama, western wheatgrass, Fendler threeawn (Aristida fendleriana), green needlegrass, sand bluestem, little bluestem, needleandthread, prairie sandreed, and plains muhly (Muhlenbergia cuspidata) making up at least 50 percent of the total plant volume with other perennial grasses, forbs, and shrubs accounting for the remainder. Sandberg bluegrass, threadleaf sedge, buffalograss, blue grama, hairy grama, heath aster, slimflower scurfpea, scarlet globemalloe, broom snakeweed (Gutierrezia sarothrae), common priclypear (Opuntia compressa), fringed sagewort, sand dropseed, skunkbush sumac (Rhus trilobata), and western snowberry (Symphoricarpos occidentalis) are the principal increasers. When the plant community is in excellent range condition the total annual production in the Panhandle area will range from 750 pounds per acre, air-dry, in unfavorable years to a high of 2000 pounds in favorable years. In the northcentral area, it will range from 1000 to 2500 pounds per acre.

The soils that support this plant type range in texture from loamy fine sand to silty clay and may be calcareous. Sandstone, siltstone, coarse gravel or shale is at a depth of 10 to 20 inches.

Savannah

The original plant community is a mixture of such decreaser grasses as little bluestem, big bluestem, sideoats grama, plains muhly, green needlegrass, prairie junegrass, slender wheatgrass (Agrophyron trachycaulum), bearded wheatgrass (Agropyron subsecundum), and western wheat-

grass making up least 65 percent of the total volume with other perennial grasses, forbs, shrubs and trees accounting for the remainder. Blue grama, prairie sandreed, hairy grama, fringed sagewort, cudweed sagewort, small soapweed, western snowberry, skunkbush sumac, and ponderosa pine (Pinus ponderosa) are the principal increasers. When the plant community is in excellent range condition, the total annual production in the Panhandle area ranges from 1500 pounds per acre, air-dry, in unfavorable years to 2500 pounds in favorable years. In the northcentral area, it will range from 2000 to 3000 pounds.

The soils where this plant type is found range in texture from loam to a very fine sandy loam and may be calcareous. Sandstone may be found at a 10 to 20 inch depth.

Native Pine and Deciduous Forest Along the
Niobrara Valley in Cherry County

Forestlands

There are two distinct forest types occurring in the Niobrara River Basin. The ponderosa pine type characteristic of the Black Hills and Rocky Mountains occurs in the canyons and rough, stony land of both the Pine Ridge area and the Niobrara River valley in Cherry, Keya Paha, Rock and Brown Counties. The understory of this forest type is made up of western snowberry, skunkbush sumac, wild rose, poison ivy, juniper, small soapweed, ponderosa pine seedlings and grasses. The scattered, open stands of pine that occur on the south and west slopes are part of the

Savannah plant community described above. Ponderosa pine forest plant communities can occur on the north and east slopes.

A deciduous forest type occurs in the canyons and along the small streams in the Pine Ridge area and along the Niobrara River valley. This deciduous forest consists mainly of green ash, American elm, box-elder, eastern redcedar, bur oak, cottonwood and willow.

F. Water Resources

The occurrence and extent of the water supply varies widely in the basin. Ground water is the principal source of supply for the municipal, industrial, and rural domestic water. Surface water is used for irrigation, livestock, power, recreation, and fish and wildlife.

Ground water occurs in varying amounts throughout the basin. It generally is not restricted by overlying, confining material. There are local areas of perched water table conditions and isolated locations of artesian wells. An estimated 500 million acre feet of ground water is in the basin's aquifers.

The water table slopes in an eastward direction, similar to the surface topography. The slope varies from nearly flat in portions of the Sandhills to as much as 60-70 feet per mile in the eastern portion of the basin. Lateral movement of the ground water averages about one foot per day. Depth to water ranges from a few feet in the stream valleys to over 250 feet in the uplands. The water table intersects the land surface in the many lakes and marshes in the Sandhills area.

Recharge to the ground water reservoir is from direct infiltration of precipitation. Basinwide net recharge is probably about one inch per year. However, in the Sandhills portion of the basin total recharge, including base flow in the stream system, may be as much as 25 percent of annual precipitation.

Transmissibility (a measure of ease of withdrawal of ground water) of upland aquifers differs considerably from place to place. Large capacity wells are more easily obtained in the Sandhills region. The combination of a thinner zone of saturation and a less-permeable water-bearing material results in wells of generally less than 500 gpm capacity in the eastern part of the basin.

Streams originating in the Sandhills area flow perennially and have a high percentage of base flow in relation to the total annual discharge. Minnechaduza Creek, Plum Creek, and Long Pine Creek are streams where base flow constitutes from 80 to 85 percent of the total annual flow. Base flow is estimated at over 90 percent in the Snake River. Conversely, base flow in Ponca Creek is about 15 percent of the total.

Records of streamflow are available from twenty active stream gaging stations on the Niobrara River and its tributaries. Three gaging

stations are located on Ponca Creek. Table II-8 is a summary of the volume of runoff measured at selected gaging stations. Most main-stem records on the Niobrara River are not included as flow is affected by reservoir releases.

Table II-8.--RUNOFF VOLUMES AT SELECTED STREAM GAGING STATIONS
NIOBRARA RIVER BASIN AND PONCA CREEK

USGS Station Number & Name	Total Drainage Area	Period of Record	Maximum Annual (& Yr.)	Median 1/ Annual	Minimum Annual (& Yr.)	Mean 2/ Annual & (Period of Record)
	Sq.Mi.	Water Yr.	---------- Acre Feet ----------			Ac. Ft. Per Sq.Mi.
NIOBRARA RIVER BASIN						
#4540 Niobrara River at the Wyo.-Nebr. Line	450	1956-1970	3,980 (1969)	2,890	2,350 (1961)	7 (7)
#4541 - Niobrara River at Agate	840	1958-1970	12,420 (1958)	10,500	9,010 (1961)	13 (13)
#4545 - Niobrara River above Box Butte Reservoir	1,400	1947-1970	30,960 (1947)	21,380	17,340 (1969)	15 (16)
#4609 - Minnechaduza Creek near Kilgore	85	1959-1970	8,920 (1962)	5,600	4,160 (1961)	66 (66)
#4610 - Minnechaduza Creek at Valentine	390	1949-1970	31,580 (1962)	25,400	20,710 (1970)	63 (65)
#4625 - Plum Creek at Meadville	600	1949-1970	101,200 (1952)	75,230	67,030 (1970)	128 (130)
#4635 - Long Pine Creek near Riverview	390	1949-1970	121,700 (1951)	94,390	80,260 (1949)	242 (246)
#4645 - Keya Paha River at Wewela, S. Dakota	1,070	1939-1940 1948-1970	126,800 (1962)	42,460	17,200 (1940)	55 (49)
#4649 - Keya Paha River near Naper	1,630	1958-1970	281,900 (1962)	88,290	57,740 (1959)	64 (64)
#4655 - Niobrara River near Verdel 3/	12,600	1959-1970	1,781,000 (1962)	1,100,500	1,014,000 (1969)	95 (95)
PONCA CREEK						
#4534 - Ponca Creek near Naper	373	1961-1970	111,700 (1962)	11,540	5,090 (1961)	58 4/ (58)
#4535 - Ponca Creek at Anoka	505	1950-1970	186,500 (1962)	24,120	5,190 (1959)	71 4/ (76)
#4536 - Ponca Creek at Verdel	812	1958-1970	248,500 (1962)	37,730	10,110 (1959)	71 4/ (73)

Source: Water Supply Papers published by Water Resources Division, U.S. Geological Survey.

1/ Tabular values for the period of record shown - equalled or exceeded one-half the years.
2/ Mean annual unit runoffs are shown for the 12-year concurrent period (1959-1970 water-years) and for the entire period of record, noted as (-).
3/ Natural flow of stream affected by irrigation and power developments.
4/ Mean annual unit runoff for the 10-year concurrent period 1961-1970.

As of September 30, 1970, 647 water right claims on the Niobrara River and 15 claims on Ponca Creek were on record with the Nebraska Department of Water Resources. Irrigation appropriations accounted for all 15 claims on Ponca Creek and for 608 claims on the Niobrara River and its tributaties. The remaining claims were for such functions as industry, municipal, livestock, resorts, recreation, fish and wildlife, drainage and power.

Chemical analysis of the ground water indicates that a few municipal wells have a high manganese and iron content (greater than 0.05 ppm and .30 ppm, respectively). Concentrations above these levels are less desirable due primarily to difficulty of removing these elements, discoloring of laundry, and impaired taste of beverages, rather than any physiological effects. The Department of Health, State of Nebraska, indicates that some areas are very high in fluorides. The concentration of total dissolves solids is higher than the limit recommended for drinking water in ground water near the Niobrara River from the proximity of Boyd County downstream. Generally, such mineralized water lacks palatability, but does not constitute a health hazard. Acclimatization to this mineralized water is not difficult and only newcomers and casual visitors may find it objectionable.

The quality of the water in all streams is suitable for agricultural use including irrigation and livestock watering, industrial use, growth and propagation of fish, waterfowl, wildlife, and most body contact water sports.

Currently (1970) the gross annual withdrawal and diversion of water is 432,500 acre feet. Irrigation demands the largest percentage of the total. Beneficial consumption varies by function and by source. Table II-9 is a summary of the current demands and consumption of the basin's water resources by selected functions.

G. Fish and Wildlife

Fishing waters in the Niobrara Basin include over 19,000 acres of standing water. About 1,750 acres of this is in eight natural lakes which range from 36 to 450 surface acres. Some 4,300 acres is in two large impoundments, the Merritt and Box Butte Reservoirs. In addition it is estimated that there are about 1,100 acres of farm ponds and 460 acres in reservoirs above grade stabilizer structures. Numerous other small lakes exist in the Sandhills which provide incidental fishing. No natural lakes exist outside of the Sandhills region.

In addition to the standing water, an estimated 1,465 miles of the streams exist which provide fishing. About 186 miles of these are Class II and Class III streams, which are streams of value to large districts of the state. About 1,279 miles are Class IV streams which are of value to smaller districts, such as counties. A significant part of the stream mileage is the Niobrara River which has an estimated 140 miles of Class III stream and 340 miles of Class IV stream. Other larger

TABLE II-9.--SUMMARY OF CURRENT ANNUAL SURFACE AND GROUND WATER DEMAND AND CONSUMPTION BY WATER-RELATED DEVELOPMENTS NIOBRARA RIVER BASIN, NEBRASKA

Item	Diversion or Withdrawal	Consumption
	(Acre Feet)	
Surface Water		
Irrigation[1/]	120,000	67,000
Livestock	2,200	2,200
Evaporation	141,000	141,000
TOTAL SURFACE	263,200	210,200
Ground Water		
Municipal, Industrial & Rural Domestic	5,000	2,000[2/]
Irrigation	143,000	114,500
Livestock	6,700	6,700
Power	14,600	5,800[2/]
TOTAL GROUND	169,300	129,000
TOTAL SURFACE & GROUND	432,500	339,200

1/ Assuming full development of Ainsworth project.
2/ Estimated at 40 percent of withdrawal.

streams are the Snake River and Plum Creek.

Generally, streams most conducive to wildlife are those having a strong base flow. In the Niobrara Basin, such streams are generally limited to those that pass through the Sandhills area and tributaries which head in the Sandhills area. These streams include the Niobrara River and the Snake River.

The natural woodland cover for wildlife includes narrow fingers adjacent to streams and an extensive area of pine trees near the Pine Ridge area in the western part of the basin. The presence of natural grasses in rangeland, especially in the Sandhills, provides habitat for species of wildlife adapted to grass cover. The cold winters limit species of wildlife to those able to withstand low temperatures. The relatively low rainfall is not conducive to waterfowl outside of the Sandhill Lake area.

A description of wildlife as a natural resource includes a description of species and their associations with specific environmental conditions. Such species are usually indigenous to the basin, but may include some introduced species.

Deer

Both white-tailed and mule deer live throughout the Niobrara Basin, being generally concentrated in or near riparian woodlands associated with the river and its tributaries. The highest population of deer occurs near the woodlands of the Niobrara River and its tributaries in Keya Paha County, where the estimated population reaches eight deer per square mile. Another area of concentration is adjacent to the Pine Ridge area in Dawes County.

Antelope

Historically, antelope occupied the Sandhills regions, before being driven from the region when the Sandhills were settled. Antelope were reintroduced into the Sandhills from 1959-1962. Nine release sites are located within the boundaries of the Niobrara Basin. Current antelope populations remain generally low.

The west end of the Niobrara Basin in Nebraska contains some of the state's highest antelope numbers. In Sioux County the population exceeds 2.0 antelope per square mile.

Turkeys

The extent of habitat that will support wild turkeys in the Niobrara Basin is relatively low. However, excellent habitat consisting of riparian and bluff woodlands (particularly the ponderosa pine associated with the river and its tributaries, and that portion of the Pine Ridge forest land extending into the Basin) do support the State's highest densities of wild turkey. Concentrations of from four to more than eight birds per square mile are common, and much of the hunting opportunity for this species occurs within the Niobrara Basin.

Upland Game Species

All upland game species hunted in Nebraska are found throughout at least a portion of the Niobrara Basin. Grouse are native to and dependent on grassland areas, with sharptails restricted largely to the Sandhills. Prairie chickens occur along the southern and eastern edge of the Sandhills where interspersion of grassland areas with croplands provide needed habitat. Pheasants are well adapted to cropland areas where adequate amounts of residual or permanent cover exist to provide wintering and nesting cover. Bobwhite quail are found in the eastern half of the basin where adequate winter cover and food supply are present. Cottontails and fox squirrels populate the riparian woodlands.

Waterfowl

Sandhill lakes and marshes of the Niobrara Basin are an essential waterfowl supporting resource of high value. In 1969, the estimated breeding population of waterfowl on Sandhill lakes was approximately 100,000, a significant portion of this occurring within the Niobrara Basin. Southern Sheridan County possesses some of the best remaining waterfowl and nesting habitat in the state.

Muskrat Feeder Houses Rice Lake, Cherry County

Furbearers

It is estimated that about 10 percent of the state's trapping activity occurs within the Niobrara Basin. The primary species sought by trappers include muskrat, beaver, mink, and raccoon, all of which are generally found in association with water areas.

H. Quality of the Natural Environment

Previous sections of this chapter give an inventory of the quantity and quality of the natural resources of the basin which are a part of the natural environment. Climate and the availability of land and water are also major factors in determining the quality of the natural environment.

In the Niobrara River Basin, the quality of the natural environment is closely related to agriculture. The major land use is pasture and range, although areas of dry land and irrigated cropland are scattered throughout the basin. Much of the environmental beauty of the landscape is that associated with agriculture.

The western part of the basin is characterized by flat table lands bordered on the north by the Pine Ridge, a scenic area of coniferous trees. The central part is located in the Sandhills region where numerous lakes and marshes provide excellent fish and wildlife habitat. The Niobrara River flows over several waterfalls with the valley slopes covered with a forest of eastern hardwoods and western pines that provide beautiful scenic vistas. Water resources are generally adequate in quantity and quality and the atmosphere relatively free from pollutants.

Soil Conservation Service Nebraska Game & Parks Commission

The Niobrara River has Many Scenic Features

Portions of the Niobrara River and its tributaries still retain much of their historic flow and natural streamside characteristics. These rivers still retain their intrinsic values in an undeveloped and unaltered state. The characteristics of their natural environment can provide opportunities for present and future generations to follow and explore free flowing streams for scientific, cultural, recreational, fish and wildlife, aesthetic, and similar purposes.

III. ECONOMIC DEVELOPMENT

Opportunities for development are influenced by the resources and economic conditions existing in the study area and surrounding region. Knowledge of current and projected economic conditions is necessary for successful resource planning. An examination of factors such as size and characteristics of the population, labor force, employment, and sources of personal income must be made to get an indication of growth. Accompanying this growth, are increased demands for the use of resources. Only by balancing our future needs with available resources can we hope to foster continued economic growth and a higher level of living. The future economy will be influenced by the historical trends. Also the direction and extent of changes will be modified by influences outside the basin and the desires of people within the basin.

A. Historical Development

The Niobrara Basin came under U. S. jurisdiction as part of the Louisiana Purchase in 1803. During the first half of the century the area was by-passed by the initial exploratory efforts of groups mapping characteristics and travel corridors through the Great Plains. Trappers and fur traders traversed the area much earlier and the Spaniard Mackey is known to have explored the river in 1796.

The first "official" report of exploration of the basin was by Lt. G. K. Warren in 1855. He crossed the eastern basin on an overland trip between Ft. Kearney and Ft. Pierre and traversed the western portion on his return trip to Ft. Laramie. Settlement of the basin was initially made by cattlemen after the Civil War. Discovery of gold in the Black Hills in 1874 and the establishment of military installations as a result of problems with the Sioux Indians furnished the impetus for permanent settlement of the basin. Bordering the Rosebud Indian Reservation on the south and possessing vast areas of grass, the basin soon had a thriving industry of cavalry posts and drovers delivering cattle to the reservation and mining camps. While early herds of cattle came from as far south as Texas, the basin was quickly settled by ranchers operating on open range. As settlement continued, the need for trees led to early tree planting on the plains and sandhills in the Niobrara Basin. The state became known as "The Tree Planting State". In 1869, Nebraska passed a tax exemption law favoring tree planting.

County organization started in the late 1870's and by the mid 1880's most of the basin was covered by organized county government. The Homestead Act of 1862, which encouraged settlement in eastern Nebraska, had little effect on the basin until the 1880's. Even though this act and a later timber claim act were unsuited for an area such as this basin, homesteaders followed the gold miners and the railroad into the basin in

the 1880's and "took up" most of the land bordering streams. This settlement ended the open range and forced the large cattlemen farther west. Inclement weather, sporatic Indian problems, and a natural environment unsuited to widespread cultivation prevented rapid and peaceful consolidation of this early settlement into a viable socio-economic structure.

Beginning in 1884, Professor Charles E. Bessey interested the University of Nebraska in tree planting in the Niobrara. Events such as these led the U. S. Department of Agriculture in 1891 to furnish tree planting stock and to assist with the first experimental planting on private lands in Holt County. In 1902, by Presidential proclamation, two units of the Nebraska National Forest were established. They are the Niobrara Division, now the Samuel R. McKelvie National Forest, in Cherry County and the Pine Ridge Division in Dawes County, Seeding and planting began in the fall of 1902. Since tree planting began in the Niobrara Basin many Acts of Congress and the State Legislature have encouraged additional tree plantings.

The Kinkaid Amendment to the Homestead Act was the most significant event in promoting and setting the pattern of settlement. This act provided that a person who had never taken a homestead could file on 640 acres. Possibly of more importance, however, was the provision which allowed earlier homesteaders on holdings of less than 640 acres to take additional land to make a total of 640 acres. These larger-size units permitted a return to more extensive cattle grazing and farming was practiced more discriminately. Gradually, settlers recognized that much of their land was not suited for farming and sold it to ranchers. Thus, the cattle ranching industry that covers four-fifths of the basin today, was established.

B. General Description

Population and Population Characteristics

The population of the Niobrara River Basin reached a peak of nearly 61,000 people in 1930 (Table III-1). The total population has since declined to 39,300 in 1970 for an average annual decline of 1.09 percent per year since 1930. Twenty-four percent of the basin's population was classified as urban in 1970, a gain in proportionate share of only one percent since 1960, but still a decline of 1,196 people. In 1970, about 38 percent of the basin's population lived on farms and ranches while the remaining 38 percent lived in rural non-farm areas or in rural communities of less than 2,500 people (Table III-2). The basin is sparsely populated representing over 15 percent of Nebraska's land area but only 2.7 percent of the state's 1970 population.

All of the population categories except "other" listed in Table III-3 declined in population during the 1950-1970 time period. Twenty-four of the 30 nonurban places had population declines while both of the urban centers, Alliance and Valentine, declined. These are and have been the only two urban centers in the basin. The gain of 66

TABLE III-1.--POPULATION 1910-1970
NIOBRARA RIVER BASIN, NEBRASKA

Year	Total Population	Urban	Total Rural	Rural Farm	Rural Nonfarm
	(Number)				
1910	52,936				
1920	59,070				
1930	60,896				
1940	55,101	8,441	46,660	31,094	15,566
1950	50,575	10,591	39,984	24,102	15,882
1960	46,359	10,720	35,639	20,627	15,012
1970	39,329	9,524	29,805	14,763	15,042

Source: U. S. Department of Commerce, Bureau of Census

people in Spencer was the largest in the basin while Clinton, with a gain of 53 percent, exhibited the greatest percentage increase. The increase in the "Other" category represents a movement of people to the rural area but with non-farm employment. The decline in population in the Niobrara Basin is typical of many basically rural areas. The basin's relatively great distance from any major urban center probably prevents commuting for employment purposes.

TABLE III-2.--PERCENTAGE DISTRIBUTION OF POPULATION BY CLASSES, 1940, 1950, 1960, 1970 NIOBRARA RIVER BASIN, NEBRASKA

Class	Niobrara			
	1940	1950	1960	1970
	(Percent)			
Urban	15.3	20.9	23.1	24.2
Rural Farm	56.4	47.7	44.5	37.5
Rural Nonfarm	28.2	31.4	32.4	38.3

Source: U. S. Department of Commerce, Bureau of Census

TABLE III-3.--CITIES AND VILLAGES GROUPED BY SIZE, 1950, 1960, 1970
NIOBRARA RIVER BASIN, NEBRASKA

Category	Number	1950 Pop.	1960 Pop.	1970 Pop.	Change 1950-1970 Numbers	Percent
Under 250	15	1,682	1,375	1,012	670	-40
250-500	6	2,244	2,074	1,897	347	-15
500-1,000	5	3,237	3,172	2,848	389	-12
1,000-2,500	4	6,565	6,256	5,998	567	- 9
Other1/		2,154	2,135	3,287	1,133	+
Over 2,500 (Urban)	2	10,591	10,720	9,524	1,067	-10

Source: U. S. Department of Commerce, Bureau of Census.
1/ This category is the rural nonfarm population living outside the corporate limits of cities and villages.

Social Structure and Institutional Arrangements

The social structure and institutional arrangement of the Niobrara River Basin reflects the rural nature of the area. The low population density results in the area residents having to travel fairly large distances for social and institutional activities. However, the remote distance from large urban centers causes most of the smaller towns to offer a wide range of services.

Schools in the basin are usually relatively small, although in recent years school consolidation has resulted in larger schools with modern facilities. No colleges are located within the basin.

Outmigration from the Niobrara Basin has been great. The natural increase (births minus deaths) in population from 1960 to 1970 was 6.3 percent while the net outmigration was 20.8 percent. The net outmigration for the non-white population was nearly 50 percent for the same ten years. In 1970, the nonwhite population accounted for about two percent of the basin's total population.

The population of the basin is projected to continue to decline through the year 2000 although at a slower rate than in the past. Population pressures and the trend to rural living are expected to cause a slight increase between 2000 and 2020. The continued decrease results from the continuing decline in the farm population and the lack of significant growth in the urban and rural non-farm categories. The population is projected to be 38,500 in 1980, 34,500 in 2000 and 33,000 in 2020 (Table III-4). The urban and rural non-farm population will grow slightly but the rural population will continue to decline in numbers.

TABLE III-4.--HISTORICAL AND PROJECTED POPULATION
NIOBRARA RIVER BASIN, NEBRASKA

Year	Total Population	Urban	Total Rural	Rural Farm	Rural Nonfarm
	(Number)				
1940	55,101	8,441	46,660	31,094	15,566
1950	50,575	10,591	39,984	24,102	15,882
1960	46,359	10,720	35,639	20,627	15,012
1970	39,329	9,524	29,805	14,763	15,042
1980	38,500	9,700	27,500	12,600	14,900
2000	34,500	10,400	25,400	10,400	15,000
2020	33,000	12,300	26,200	9,200	16,900

Major Types of Economic Activity

An indication of the economic activity in the Niobrara River Basin area is given in Table III-5.

TABLE III-5.--EARNINGS BY BROAD INDUSTRIAL SECTOR, 1968,
NIOBRARA ECONOMIC AREA, NEBRASKA[1/]

Sector	Thousand Dollars	Percent
Farm	35,992	38
Federal Government	3,023	3
State and Local Government	10,986	12
Manufacturing	1,963	2
Mining	42	2/
Contract Construction	2,370	3
Transportation, Communications, & Utilities	6,346	7
Wholesale and Retail Trade	19,388	20
Finance, Insurance, & Real Estate	2,836	3
Services	10,896	11
Other	607	1
Total	94,423	100

Source: Office of Business Economics

1/ Seven county area including Box Butte, Boyd, Brown, Cherry, Holt, Keya Paha and Sheridan Counties.

2/ Less than 0.5 percent.

Earnings by broad industrial sectors for 1968 are presented for a seven county area approximating the Niobrara Basin. The largest sector is agriculture with 38 percent of the total earnings. Wholesale and retail trade account for 20 percent while the two sectors--state and local government and services--each account for 12 percent of the total earnings.

There are 76 manufacturing firms in the Niobrara Basin (Table III-6). The largest group of firms is in the printing, publishing and allied industries with 25 firms, most of which are either newspaper publishers or commercial printers. The food and kindred products group has 19 firms, six of which produce prepared feeds for animals and fowl and five are meat packing plants.

TABLE III-6.--NUMBER OF MANUFACTURING FIRMS BY MAJOR GROUP
(STANDARD INDUSTRIAL CLASSIFICATION)
NIOBRARA RIVER BASIN, NEBRASKA

Major Group	Employment-Size Class 1/				
	A	B	C	D	Total
	-----(Number of Firms)------				
Food and Kindred Products	12	5	2	0	19
Apparel & Other Finished Products Made From Fabrics & Similar Materials	1	0	0	0	1
Lumber & Wood Products, Except Furniture	4	0	0	0	4
Printing, Publishing & Allied Industries	24	0	1	0	25
Chemicals & Allied Products	0	1	0	0	1
Stone, Clay, Concrete & Glass Products	4	2	0	0	6
Fabricated Metal Products, Except Ordinance Machinery & Transportation Equipment	1	0	0	1	2
Machinery, Except Electrical	9	0	0	0	9
Electrical Machinery, Equipment & Supplies	2	0	0	0	2
Transportation Equipment	1	0	0	0	1
Professional Scientific & Controlling Instruments; Photographic & Optical Goods; Watches & Clocks	2	0	0	0	2
Miscellaneous Manufacturing Industries	4	0	0	0	4
Total	64	8	3	1	76

Source: Directory of Nebraska Manufacturers and their products, 1970-71.

1/ Employee Code: A - under 10; B - 10 to 24; C - 25 to 49; D - 50 to 99 employees in each firm.

The number of firms grouped by number of employees is also given in Table III-6. Only one firm, producing fabricated metal products, employs more than 50 employees. Eighty-four percent of the firms employ less than ten employees.

Employment

Total employment in the Niobrara River Basin in 1970 totaled 14,290, down about 2,590 from 1960 (Table III-7). The relative importance of employment in the basic industries declined between 1960 and 1970 due mainly to the decline in both agriculture and manufacturing employment. Agriculture is the largest employer in the basin, accounting for about 36 percent of the total employment in 1970. However, agriculture employment's proportion was down seven percent from 1960.

TABLE III-7.--EMPLOYMENT, 1960 AND 1970
NIOBRARA RIVER BASIN, NEBRASKA

Industry	Employment 1960	Employment 1970	% of Change 1960-1970
Agriculture, Forestry & Mining	7,247	5,160	-29
Manufacturing	598	320	-47
Basic Industry Total	7,845	5,480	-30
Construction	756	570	-25
Transportation, Communications and Utilities	1,184	990	-16
Wholesale & Retail Trade	3,067	3,090	+ 1
Finance, Insurance & Real Estate	374	410	+10
Services	3,650	3,760	+ 3
Non-Basic Industry Total	9,031	8,810	- 3
Total	16,876	14,290	-15

Source: U. S. Department of Commerce, Bureau of Census (U. S. Census of Population)

The largest nonbasic industry in the basin is the services sector with 3,760 employees or 26 percent of the total employment. The wholesale and retail trade industry has 22 percent and the transportation, communications and utilities 7 percent of the basin's total employment. In comparison with the State of Nebraska employment trends, the basin employment growth rate is lagging in most nonagricultural industries.

Total employment is projected to be 13,800 in 1980, 13,600 in 2000 and 15,000 in 2020 (Table III-8). Agriculture employment is projected to decline to 4,500 in 1980, 3,700 in 2000 and 3,300 in 2020 for a decline of 37 percent between 1970 and 2020. Nonagricultural employment

is projected to increase only 29 percent during the same time period.

TABLE III-8.--HISTORICAL AND PROJECTED EMPLOYMENT
NIOBRARA RIVER BASIN, NEBRASKA

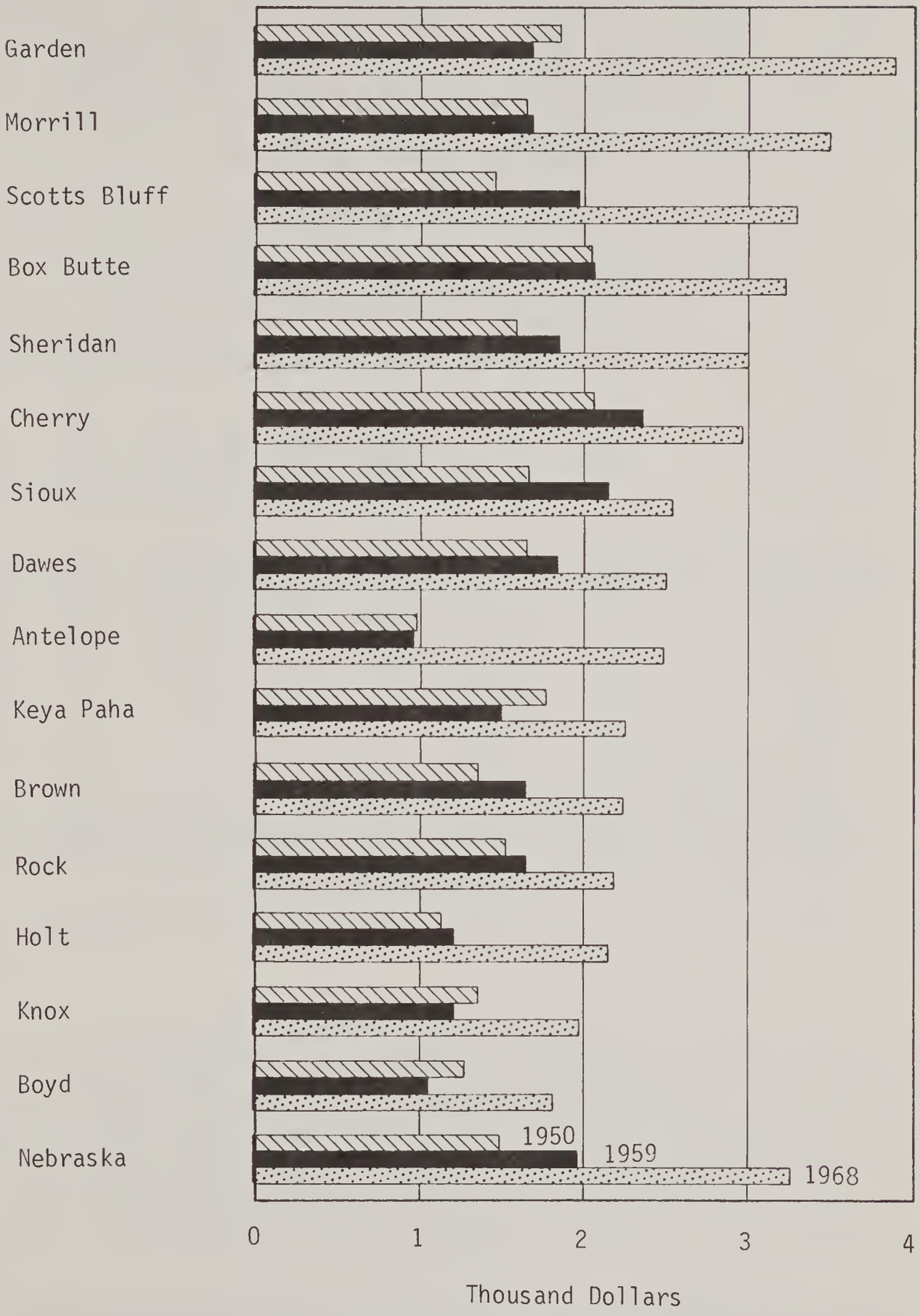
Year	Agricultural Employment	Nonagricultural Employment	Total Employment
	(Thousands)		
1950	8.7	9.8	18.5
1960	5.2	9.7	16.9
1970	5.2	9.1	14.3
1980	4.5	9.3	13.8
2000	3.7	9.9	13.6
2020	3.3	11.7	15.0

The historical employment data indicates that if the employment decline is to be reversed, industries other than agriculture must grow at a more rapid pace than has occurred historically. The agriculture industry has changed from a labor-intensive, low-capitalized industry to a highly mechanized, highly capitalized industry. However, the projected increases in agricultural production may require some increases in employment in agriculture related businesses.

Income

Per capita income has risen rapidly in most counties in the Niobrara River Basin (Figure III-1). The increase was much larger between the years 1959 to 1968 than was the increase between the years 1950 to 1959. Although actual output of the basin has been increasing, much of the increase in per capita income can be attributed to price inflation and a declining population while total personal income has been increasing. The avergae per capita income for the basin was $1,663 in 1950, $1,749 in 1959 abd $2,669 in 1968. The per capita income (in 1958 dollars) is projected to increase to $3,667 by 1980, $6,417 by 2000 and $11,294 in 2020. Garden, Morrill and Scotts Bluff Counties had the highest per capita incomes in 1968. However, these three counties do not represent a very large portion of the basin. Box Butte County at $3,213 had the highest per capita income of any county lying significantly within the basin. Boyd County was lowest at $1,806. The average per capita income for Nebraska in 1968 was $3,239. Total personal income for the basin in 1968 was about $105 million. By 1980, the total personal income is projected to increase 35 percent above the 1968 level. The 2000 and 2020 levels are projected to be 111 percent and 255 percent above the 1968 level.

Figure III-1.--PER CAPITA INCOME BY COUNTY, 1950, 1959 & 1968
NIOBRARA RIVER BASIN, NEBRASKA



Personal income of the Niobrara Economic Area1/ in 1968 totaled nearly $129 million, the highest total personal income since 1962 (Table III-9). The total personal income in 1968 was distributed as follows: total wage and salary disbursements - 34 percent; other labor income - 1 percent; proprietors income - 37 percent; property income - 17 percent; and transfer payments - 11 percent. Total earnings in 1968 were nearly $95 million. Total earnings is defined as the sum of total wage and salary disbursements, other labor income, and proprietors income. Thirty-eight percent of the total earnings in 1968 were farm earnings. This was down from 64 percent in 1950 and 44 percent in 1959.

Table III-9.--PERSONAL INCOME 8Y MAJOR SOURCE AND EARNINGS 8Y 8ROAD SECTOR FOR SELECTED YEARS 1929 THROUGH 1968, NIOBRARA ECONOMIC AREA, NE8RASKA 1/

Major Source	Year								
	1929	1940	1950	1959	1962	1965	1966	1967	1968
	(Thousands of Dollars)								
Total Personal Income	37,404	24,204	91,157	90,225	117,041	99,459	106,439	116,556	128,670
Total Wage and Salary Disbursements	11,339	8,286	24,235	31,295	35,289	36,777	39,291	40,618	45,010
Other Labor Income	110	89	359	828	982	1,250	1,367	1,480	1,551
Proprietors Income	22,868	12,375	53,748	37,528	56,626	36,465	39,409	43,360	48,041
Property Income	2,371	2,460	9,289	15,243	17,501	17,351	18,063	21,762	22,892
Transfer Payments	767	1,105	4,077	6,664	8,384	9,536	10,566	12,312	14,176
Less: Personal Contributions for Social Insurance	51	111	551	1,333	1,741	1,920	2,257	2,976	3,000
Total Earnings 2/	34,317	20,750	78,342	69,651	92,897	74,492	80,067	85,458	94,602
Farm Earnings	21,928	10,729	50,024	30,765	48,774	26,944	30,231	32,398	35,992
Total Nonfarm Earnings	12,389	10,021	28,318	38,886	44,123	47,548	49,836	53,060	58,610
Government Earnings	1,792	2,672	4,997	7,544	9,165	10,289	11,289	12,420	14,009
Total Federal	544	1,531	1,247	2,058	2,441	2,798	2,771	2,861	3,023
Federal Civilian	532	1,512	1,038	1,584	1,920	2,342	2,264	2,344	2,483
Military	12	19	209	474	521	456	507	517	540
State and Local	1,248	1,141	3,750	5,486	6,724	8,021	8,518	9,559	10,986
Private Nonfarm Earnings	10,597	7,349	23,321	31,342	34,958	36,729	38,547	40,640	44,601
Manufacturing	593	298	788	1,411	1,227	1,206	1,326	1,461	1,963
Mining	34	7	71	78	90	88	36	32	42
Contract Construction	783	348	2,075	2,131	2,729	1,791	1,862	1,597	2,370
Trans., Communication, and Public Utilities	2,085	1,304	3,433	4,941	5,032	5,494	5,616	5,895	6,346
Wholesale and Retail Trade	3,915	3,333	11,285	14,459	15,954	16,371	17,344	18,100	19,388
Finance, Insurance, and Real Estate	625	297	861	1,660	1,796	2,370	2,486	2,523	2,836
Services	2,524	1,733	4,523	6,364	7,377	8,556	8,922	9,938	10,896
Other	19	16	263	613	730	863	911	1,050	607

Source: 8ureau of Economic Analysis, Regional Economics Information System.

1/ The economic area includes 8ox Butte, 8oyd, 8rown, Cherry, Holt, Keya Paha and Sheridan Counties.
2/ Individual items will not always add to given totals due to disclosure problems in individual counties.

Total nonfarm earnings have been increasing steadily since 1940. Wholesale and retail trade in 1968 was $19 million for one-third of the total nonfarm earnings. The next two largest sectors, state and local government and services, each accounted for 19 percent. In the past ten years, the state and local government sector has doubled its earnings while the finance, insurance and real estate and services have grown 71 percent. During the same time period, mining declined about 46 percent.

1/ Box Butte, Boyd, Brown, Cherry, Holt, Keya Paha, and Sheridan Counties.

Total personal income and total earnings in 1968 were at levels of five and three times the 1929 level. However, there has been much year-to-year variation as is indicated in Figure III-2. Much of the variation is related to variation in proprietors income which includes farm earnings. The direction of the year-to-year change in proprietors income and farm earnings has been the same between all years given in Figure III-2. Thus, stabilization of total personal income in the Niobrara Basin may depend on developments in the agriculture sector.

A general indicator of the relative position of agriculture in the basin as compared to agriculture in Nebraska and the United States is the farm operator "Level-of-Living Index 1/ (Table III-10). The indicator reveals that the farm operator's "level-of-living" in the basin was slightly above the state average in 1959 and 1964. The index for the basin was considerable higher than the national average in 1950, 1959, and 1964. The rate of increase in this index between 1959 and 1964 has been about equal with Nebraska's but somewhat slower than for the United States.

TABLE III-10.--LEVEL OF LIVING INDEX
NIOBRARA RIVER BASIN, NEBRASKA

Area	1950	1959	1964	Percent Change 1950-1959	Percent Change 1959-1964
Niobrara	79	126	146	59	16
Nebraska	82	123	142	50	15
United States	59	100	122	69	22

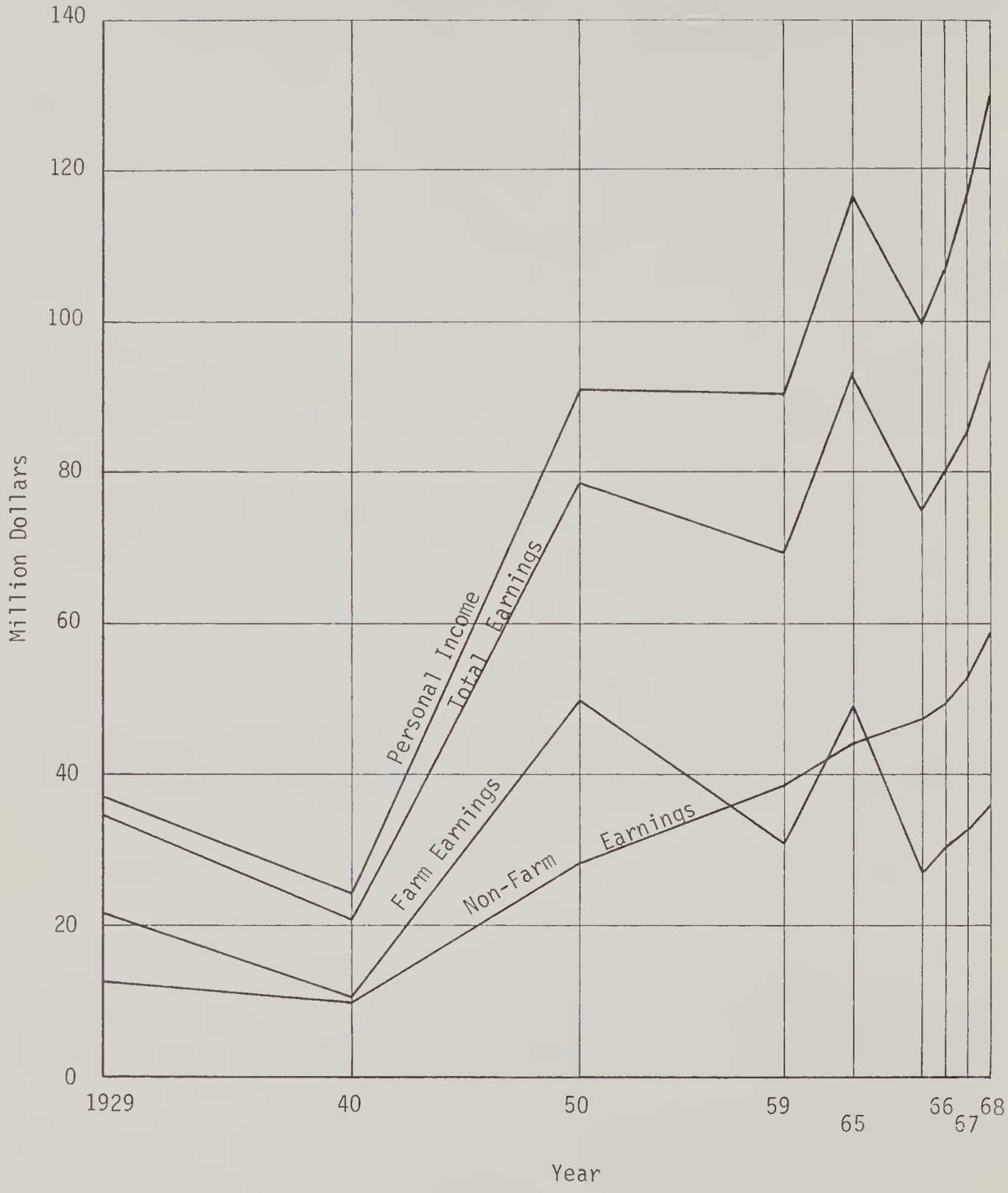
Source: Farm Operator Level of Living Indexes, for Counties of the United States, 1950, 1959 and 1964, Stat. Bul. #406, Economic Research Service, U. S. Department of Agriculture

Transportation

The transportation system of the Niobrara Basin is commensurate with the sparce population of the area. Local roads are not very numerous, but in general the road system of the basin is adequate. Federal highway U.S. 20 is the only east-west highway that traverses the basin. North-south highways include U.S. highways 385, 83, 183 and 281 and state highways 29, 71, 2, 87 and 27. State highway 12 crosses the northeast corner of the basin.

1/ This index is based upon five variables which are believed to reflect levels of living. These variables are: (1) average value of products sold per farm, (2) average value of land and buildings per farm, (3) percentage of farms with telephones, (4) percentage of farms with home freezers, and (5) percentage of farms with automobiles.

FIGURE III-2.--PERSONAL INCOME AND EARNINGS
NIOBRARA ECONOMIC AREA, NEBRASKA



Daily bus service is available from Omaha to Rapid City via Highway U. S. 20.

North and south connections are available at various points in the basin.

There are 12 municipal airports in the basin but only Alliance has commercial air service. Many residents of the basin own small aircraft and have private landing strips.

Railroad passenger service is not available to the residents of the basin. However, the Burlington Northern and the Chicago and North Western Railway Companies provide freight service.

C. Agriculture and Related Economic Activity

Farm Characteristics

The agriculture industry has experienced significant changes since World War II. Many of the trends evident in the United States and Nebraska are also evident in the Niobrara River Basin. As indicated in Table III-1, the farm population has been declining. Associated with the decline in farm population is a decline in the number of farms. The land in farms in the basin has remained almost constant over the last 20 years, with the result that there has been an increase in the average size of farm. Significant characteristics are shown in Table III-11.

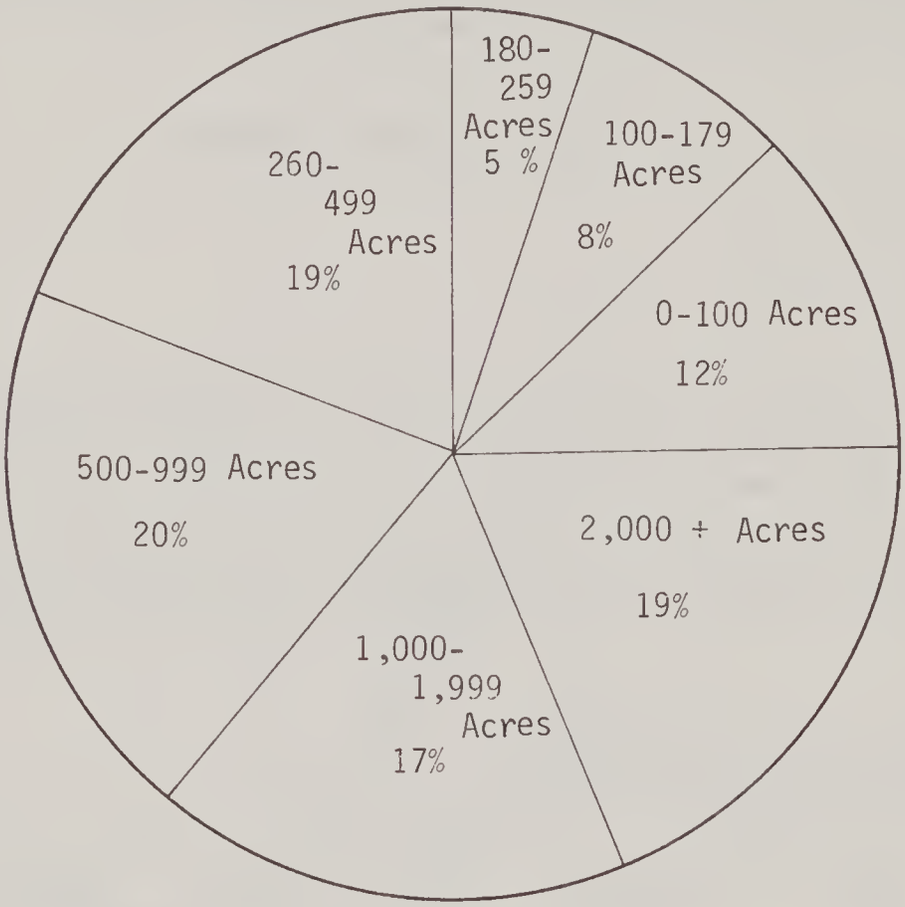
Table III-11.--FARM CHARACTERISTICS
NIOBRARA RIVER BASIN, NEBRASKA

Item	Unit	1954		1959		1964		1969	
Number of Farms	No.	5,697		5,165		4,655		4,396	
Average Size	Ac.	1,250		1,412		1,562		1,575	
Value of Land & Buildings									
Per Farm	Dol.	37,435		60,624		85,513		108,790	
Per Acre	Dol.	30		42		55		69	
Ownership of Farms:			%		%		%		%
Full Owners	No.	2,239	39	2,006	39	1,791	38	1,900	43
Part Owners	No.	1,803	32	1,752	34	1,711	37	1,603	37
Managers	No.	59	1	42	1	50	1	N.A.	
Tenants	No.	1,596	28	1,365	26	1,103	24	893	20

Source: U. S. Department of Commerce, Bureau of Census, U. S. Census of Agriculture.

The number of farms in the Niobrara Basin in 1969 was 4,396, down 1,301 or 23 percent from 1954. The decline for Nebraska was 28 percent during the same time period. Farms in the basin are relatively large. The average size of farms has increased from 1,250 acres in 1954 to 1,575 acres in 1969. Comparable figures for Nebraska are 471 and 634 acres respectively. In 1969, 75 percent of the farms were 260 acres or larger. Nineteen percent were larger than 2,000 acres (Figure III-3).

FIGURE III-3.--FARM SIZE DISTRIBUTION, 1969
NIOBRARA RIVER BASIN, NEBRASKA

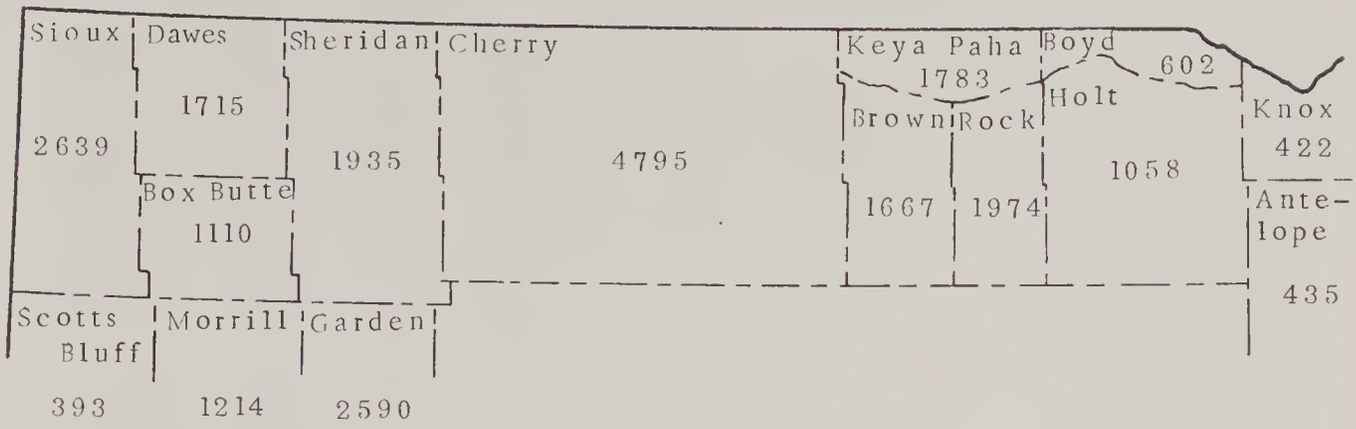


Source: U. S. Department of Commerce, Bureau of Census, U. S. Census of Agriculture

The average size of farms given are actually not representative of farms in the basin (Figure III-4). The largest farms or ranches were in Cherry County where in 1969 the average farm size was 4,795 acres and ten of the 15 counties in the basin had an average farm size of 1,000 acres or more.

The value of land and buildings in the Niobrara River Basin has increased rapidly in recent years. The value per farm increased from $37,000 in 1954 to $109,000 in 1969. This increase can be attributed to an increase in the value of land per acre and the decrease in the number of farms. The value of land per acre has increased from $30 in 1954 to $69 in 1969.

FIGURE III-4.--AVERAGE SIZE OF FARMS, IN ACRES, 1969
NIOBRARA RIVER BASIN COUNTIES, NEBRASKA



Source: U. S. Department of Commerce, Bureau of Census, U. S. Census of Agriculture

Full ownership of farms accounted for 43 percent of all farms in 1969. This was up four percent since 1954. Part ownership has increased from 32 percent in 1954 to 37 percent in 1964 indicating that the increasing land values, farm sizes and required large capital investment is and will continue to be a deterrent to full ownership of farms by the farm operator. The proportion of tenancy dropped eight percent between 1954 and 1969 while for Nebraska, the proportion of tenancy dropped fifteen percent during the same time period.

Total gross income of all farms in the Niobrara Economic Area totaled nearly $137 million in 1968, down $3 million from the $140 million in 1966 (Table III-12). In 1968, the total production expenses of all farms amounted to $104 million or 76 percent of the total gross income leaving a total net income for all farms (including corporations) of $33 million. The 1968 total net income was the highest since the $43 million value in 1962. Total net income of farm proprietors (total net income of all farms including corporations minus the statistical discrepancy) has followed the same trend as the total net income of all farms including corporations. The realized net income of farm proprietors reached a new high of $37 million in 1968. This was considerably above previous years although a negative change in inventories of $5 million added to the higher realized income. Realized net income is equal to the total net income of farm proprietors minus the change of inventory of farm proprietors.

The cash receipts from livestock make up a major portion of the total gross income of all farms in the Niobrara Economic Area. The percentage of total gross income received from livestock was 82 percent in both 1959 and 1968 with a low of 63 percent occurring in 1950. The cash

Table III-12.--FARM INCOME AND EXPENDITURES FOR SELECTED YEARS, 1959 THROUGH 1968
NIOBRARA ECONOMIC AREA, NEBRASKA 1/

Item	Year								
	1929	1940	1950	1959	1962	1965	1966	1967	1968
	(Thousand Dollars)								
Realized Net Income - Farm Proprietors	16,544	9,335	32,999	29,864	28,777	15,543	20,896	23,928	36,820
Total Net Income - Farm Proprietors	18,621	9,242	44,603	25,506	43,236	22,508	25,050	27,446	31,735
Total Net Income - All Farms (Including Corp.)	18,610	9,223	45,951	25,735	42,957	23,518	26,544	29,523	32,729
Total Gross Income - All Farms	43,239	23,409	96,656	92,705	115,325	119,757	140,097	139,332	136,799
Cash Receipts - Livestock	29,451	16,879	60,459	76,336	78,031	84,743	99,903	102,441	112,702
Meat Animals	25,335	14,175	55,838	72,368	74,381	81,227	96,005	98,627	108,828
Dairy Products	2,558	1,660	2,342	2,591	2,435	2,714	2,997	3,127	3,246
Poultry	1,558	1,044	2,279	1,377	1,215	802	901	687	628
Cash Receipts - Crops	6,842	1,458	17,548	13,106	12,833	13,947	20,828	22,028	17,707
Truck Crops & Melons	17	21	2	20	16	8	8	8	12
Fruits & Nuts	--	4	12	2	2	10	10	10	10
Greenhouse, Nurs. & Forest	40	22	121	52	62	161	167	155	160
Other Field Crops	6,785	1,411	17,413	13,032	12,753	13,768	20,643	21,855	17,525
Government Payments, Part 1	--	2,199	495	1,441	1,554	871	1,059	1,106	--
Conservation Including Great Plains	--	2,199	495	529	685	651	771	748	--
Soil Bank	--	--	--	912	869	220	203	200	--
Cropland Adjustment	--	--	--	--	--	--	85	158	--
Government Payments, Part 2	--	82	88	366	2,148	5,547	5,416	4,342	414
Feed Grains	--	--	--	--	1,116	3,452	2,965	1,884	--
Wheat	--	81	--	--	694	1,700	2,049	2,096	--
Sugar	--	1	88	271	271	375	368	336	362
Wool	--	--	--	95	67	20	34	26	52
Government Payments, Part 3		181	--	--	--	--	--	--	4,976
Government Payment Excluding Sugar & Wool	--	181	--	--	--	--	--	--	4,976
Other	6,946	2,610	18,066	1,456	20,759	14,649	12,891	9,415	1,000
Home Consumption	2,430	1,309	2,476	1,675	1,444	1,198	1,213	891	821
Imputed Rent	1,233	778	1,466	2,125	2,386	3,466	3,374	3,585	3,848
Rent Received by Farm Landlords	1,206	616	2,520	2,014	2,470	2,930	4,150	1,421	1,416
Change of Inventory	2,077	-93	11,604	-4,358	14,459	7,055	4,154	3,518	-5,085
Total Production Expenses - All Farms	24,629	14,186	50,705	66,970	72,368	96,239	113,553	109,809	104,070
Major Production Expense, Part 1	8,543	5,522	22,681	24,292	27,130	34,241	42,786	40,593	42,644
Expenditures for Feed	2,225	1,049	6,892	8,567	10,077	9,558	10,750	11,196	11,807
Expenditures for Livestock Purchases	3,790	2,283	11,188	12,007	12,491	19,827	25,160	25,072	26,522
Rent Paid to Farm & Nonfarm Landlords	2,528	1,290	4,601	3,718	4,562	4,856	6,876	4,325	4,315
Other	16,086	8,664	28,024	42,678	45,238	61,998	70,767	69,216	61,426
Statistical Discrepancy - All Farms	11	19	-1,426	-229	279	-1,010	-1,494	-2,077	-994
Change of Inventory - Farm Proprietors	2,077	-93	11,604	-4,358	14,459	7,055	4,154	3,518	-5,085
Total Gross Income Minus Government Payments - All Farms	43,239	20,948	96,073	90,898	111,623	113,339	133,622	133,884	131,409

Source: Bureau of Economic Analyses, Regional Economics Information System.
1/ The economic area includes Box Butte, Boyd, Brown, Cherry, Holt, Keya Paha, and Sheridan Counties.

receipts from livestock have increased every year since 1940 reaching a high of $113 million in 1968. The majority of the cash receipts from livestock are received from the sale of meat animals (cattle and hogs). Dairy products receipts have expanded slightly since 1962 while poultry receipts continue to decline and are a less significant source of income (Figure III-5).

Cash receipts from crops were $18 million in 1968 and $22 million in 1967, accounting for 13 percent and 16 percent respectively of total gross income. Government payments were over $5 million in 1968 for four percent of total gross income. Other sources of income have shown much fluctuation mainly because of the inclusion of the change of inventory item which has fluctuated from a high of $14 million in 1962 down to a low of a negative $5 million in 1968. The value of home consumption has declined for all but one year since 1950.

FIGURE III-5.--FARM INCOME AND EXPENDITURES
NIOBRARA ECONOMIC AREA, NEBRASKA

Total production expenses rose steadily from 1940 to 1966 but then declined in 1967 and 1968. Most of the decline has occurred in rent paid to farm and nonfarm landlords and in the "other" category of expenses. However, the expenditures for feed and for livestock purchases were at record highs of over $11 million and $26 million in 1968.

The cash receipts from livestock may be better illustrated as value added if expenditures for livestock purchases are subtracted. Feeder cattle purchases were 24 percent of livestock cash receipts in 1968. The value added was $86 million compared to cash receipts of nearly $113 million. If the $12 million expenditure for feed is also netted out, the value added in 1968 drops to $74 million. The $12 million expenditure for feed was ten percent of cash receipts from livestock.

Land Use and Production

The 1967 Conservation Needs Inventory indicates that there are 7,089,900 acres of private agricultural land in the Niobrara River Basin. This is divided between major land uses as follows: Cropland - 19 percent; Pasture and Range - 78 percent; Forest - 2 percent; and Other - 1 percent.

Portions of six land resource areas (LRA) lie within the Niobrara Basin. LRA 65 is the largest LRA in the basin, accounting for 41 percent of the basin's agricultural land (Table III-13). Ninety-eight percent of this LRA is in pasture and range use. Nineteen percent of the agricultural land is in LRA 66 and 16 percent in LRA 64. LRA's 63 and 67 account for 12 percent and 11 percent, respectively. Only a very small portion of LRA 102 is included in the basin. Pasture and rangeland predominates in LRA 63, 65, 66, and 67. The majority of the basin's cropland is located in LRA's 63, 64, and 66.

The acreage of cropland and forest and woodland has been declining steadily since 1949 while the acreage of pasture and range has been increasing.

Table III-13.--LAND RESOURCE AREAS AND MAJOR LAND USE OF PRIVATE AGRICULTURAL LAND, NIOBRARA RIVER BASIN, NEBRASKA

LRA 1/	Acres	Cropland	Pasture & Range	Forest	Other
		(Percent)			
63	870,758	27	64	6	3
64	1,145,943	49	49	1	1
65	2,888,024	2	98	*	*
66	1,355,603	27	69	3	1
67	748,488	10	90	0	0
102	81,063	67	27	3	3
Total	7,089,880	19	78	2	1

Source: Nebraska 1967 Conservation Needs Inventory
*Less than 0.5 percent.
1/ See Table II-6 for LRA Descriptions.

The acreage of non-inventory lands is expected to increase thus reducing the acreage available for agricultural uses. Land depletions were projected for transportation, urban and built-up areas only. These depletions are projected to be small, decreasing the inventory acreage only by 2,500 acres by 1980, 7,500 acres by 2000 and 15,800 acres by 2020 (Table III-15).

Wheat, corn, alfalfa hay and other tame hays have been the major crops historically in the basin (Table III-14). A significant acreage of oats has also been grown. The acreage of wheat, corn, oats, barley, and potatoes have all declined more than 40 percent between 1949 and 1964. Alfalfa hay and other tame hays are the only two major crops increasing in acreage. Although smaller in absolute acres, sorghum, silage, soybeans and sugar beet acreages have been expanded in the basin. The largest land use is pasture and range. Lying within the Nebraska Sandhills, the grazing of the large pasture and range resource has been the major agricultural activity in the basin.

TABLE III-14.--HISTORICAL LAND USE
NIOBRARA RIVER BASIN, NEBRASKA

Crop	1949	1954	1959	1964
	(Thousand Acres)			
Wheat	243	171	153	144
Rye	53	24	25	23
Soybeans	*	1	*	5
Corn, Grain	313	262	214	154
Grain Sorghum	2	15	11	30
Silage	3	14	20	25
Oats	140	157	103	78
Barley	55	37	29	15
Alfalfa Hay	86	200	227	220
Other Hay	95	91	73	118
Dry Beans	7	8	10	9
Potatoes	5	4	3	2
Sugar Beets	3	6	7	13
Pasture 1/	4,919	4,950	5,256	5,173

Source: U. S. Department of Commerce, Bureau of Census, U. S. Census of Agriculture
*Less than 500 acres
1/ Includes cropland pasture, woodland pasture and other pasture.

Table III-15.--PRESENT AND PROJECTED LAND USE
NIOBRARA RIVER BASIN, NEBRASKA

Land Use	Present	1980	2000	2020
	(Thousand Acres)			
CROPLAND	1,337	1,336	1,336	1,334
Nonirrigated	1,192	1,067	1,041	1,029
Wheat	166	165	156	194
Rye	24	28	33	53
Soybeans	6	6	6	10
Corn, Grain	117	88	81	77
Sorghum, Grain	27	32	40	56
Silage	27	12	20	20
Oats	84	94	59	29
Barley	9	17	17	16
Alfalfa Hay	201	146	166	161
Other Hay	67	58	64	63
Cropland Pasture	78	78	78	78
Other Crops	4	4	4	4
Fallow	215	192	182	183
Idle	168	147	136	85
Irrigated	145	270	295	305
Corn, Grain	66	150	174	185
Silage	8	12	17	17
Alfalfa Hay	24	43	48	46
Dry Beans	13	7	10	7
Potatoes	3	2	2	3
Sugar Beets	11	14	16	19
Other Crops	10	10	10	10
Idle	10	32	18	18
PASTURE & RANGE	5,584	5,582	5,578	5,572
Wild (Native) Hay	642	642	642	641
Pasture & Range	4,942	4,940	4,936	4,931
FOREST & WOODLAND	119	119	119	119
Grazed	105	105	105	105
Non-Grazed	14	14	14	14
OTHER	50	50	49	49
TOTAL PRIVATE AGRICULTURAL LAND	7,090	7,087	7,082	7,074

Source: Present is based upon an average of the five years 1966-1970 and data from the Missouri River Basin Comprehensive Framework Study, 1969.

Present 1/ and projected land use are shown in Table III-15. The acreage of irrigated land is projected to increase from the present 145,000 acres to 270,000 by 1980, 295,000 by 2000 and 305,000 by 2020. The projected irrigation development is private development only. The irrigated acreage has been increasing rapidly in recent years. The 1961 irrigated acreage in the basin was about 79,000 acres.

On nonirrigated cropland the present wheat acreage of 166,000 acres is projected to remain almost constant through 2000 but then increase to 194,000 acres by 2020. The corn for grain acreage is projected to decline gradually through 2020. The oats acreage increases from 84,000 presently to 94,000 by 1980 but then declines rapidly to 29,000 by 2020. Alfalfa hay acreage will be down nearly 20 percent by 2020.

The projected increase in irrigated acreage results in a rapid increase in the acreage of irrigated corn. The present 66,000 acres is projected to increase to 185,000 acres by 2020. Alfalfa is the only other major irrigated crop in the basin. Although relatively small, the acreage of silage and sugar beets is projected to double by 2020.

Crop yields have been increasing historically and are projected to continue to increase through 2020. Present and projected yields are shown in Table III-16. The estimate of yield increases assume continued improvements in management, conservation and utilization of the soil resource, improved varieties of field crops and grasses, improved types of fertilizer and greater acceptance and application of net technology. Wheat yields are projected to more than double by 2020. Both nonirrigated and irrigated corn yields increase about 84 percent by 2020, while nonirrigated and irrigated alfalfa yields increase 54 percent and 61 percent, respectively. Pasture and range yields are projected to increase 59 percent by 2020.

Present and projected production levels were established for the Niobrara Basin. These production levels are based on national and regional levels of food and fiber output. The national projections include consideration of population growth; shifts in consumer demands; industrial and other uses of agricultural commodities; livestock feeding efficiencies and feed ration composition; foreign demand for agricultural production; and the advance of technology in the production of crops and livestock. The Niobrara was specifically related to the Platte Subbasin with certain modifications where recent data indicated significant trend changes. For example, annual data available since 1964 indicate rapid increases in corn production and cattle on feed in the Niobrara Basin (Table III-17). Consequently, the beef, veal and corn production levels were set significantly higher than the trends in the Platte Subbasin would indicate.

The projected livestock production levels are converted into feed unit consumption levels based on published feeding efficiencies and

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1/ Present is based upon an average of the five years 1966-1970 and data from the Missouri River Basin Comprehensive Framework Study, 1969.

TABLE III-16.--PRESENT AND PROJECTED YIELDS
NIOBRARA RIVER BASIN, NEBRASKA

Crop	Unit	Present	1980	2000	2020
Non-Irrigated					
Wheat	Bu.	28	40	52	61
Rye	Bu.	19	24	28	31
Soybeans	Bu.	21	24	27	29
Corn, Grain	Bu.	37	47	58	68
Sorghum, Grain	Bu.	33	39	49	58
Corn, Silage Equiv.	Ton	6.7	7.7	8.7	9.6
Oats	Bu.	34	42	52	61
Barley	Bu.	35	41	50	56
Alfalfa Hay	Ton	1.3	1.5	1.8	2.0
Other Hay	Ton	1.3	1.5	1.8	2.0
Cropland Pasture	F.U. 1/	1,400	1,639	1,828	1,943
Irrigated					
Corn, Grain	Bu.	93	119	148	172
Corn, Silage	Ton	14.0	56.6	17.4	19.1
Alfalfa Hay	Ton	3.3	3.8	4.6	5.3
Dry Beans	Cwt.	17.6	18.1	19.1	19.8
Potatoes	Cwt.	230	265	310	347
Sugar Beets	Ton	15.0	17.2	19.3	21.2
Wild (Native) Hay	Ton	.8	1.0	1.2	1.3
Pasture & Range	F.U.	470	571	672	748
Grazed Woodland	F.U.	195	204	217	227

Source: Present is based upon an average of the five years 1966-1970 and data from the Missouri River Basin Comprehensive Framework Study, 1969.

1/ A Feed Unit, (F.U.) equals one pound of corn or its equivalent.

Table III-17.--PRESENT AND PROJECTED PRODUCTION
NIOBRARA RIVER BASIN, NEBRASKA

Commodity	Unit	Price 1/	Present 3/		1980		2000		2020	
			Production	Dollar Value	Production	Dollar Value	Production	Dollar Value	Production	Dollar Value
			(Thousands)							
Wheat	Bu.	1.78	4,698	8,362	6,532	11,627	8,090	14,400	11,852	21,097
Rye	Bu.	.87	455	396	666	579	936	814	1,647	1,433
Soybeans	Bu.	2.30	129	297	140	322	162	373	293	674
Dry Beans	Cwt.	5.99	220	1,318	119	713	187	1,120	144	863
Potatoes	Cwt.	1.38	666	919	395	545	573	791	858	1,184
Sugar Beets	Ton	12.17	158	1,923	242	2,945	300	3,651	404	4,917
Corn, Grain	Bu.	1.10	10,445	11,490	21,899	24,089	29,060	31,966	34,766	38,243
Sorghum, Grain	Bu.	.97	883	857	1,261	1,223	1,938	1,880	3,235	3,138
Oats	Bu.	.60	2,866	1,720	3,945	2,367	3,061	1,837	1,760	1,056
Barley	Bu.	.79	305	241	698	551	834	659	876	692
Silage	Ton	8.00	300	2,400	285	2,280	570	4,560	628	5,024
Hay	Ton	17.82	863	15,379	1,017	18,123	1,309	23,326	1,437	25,607
Pasture 2/	F.U.	.015	1,643	24,642	1,990	29,848	2,332	34,976	2,587	35,503
Beef & Veal	Cwt.	25.43	1,849	47,020	2,991	76,061	4,365	111,002	5,206	132,389
Pork	Cwt.	15.05	510	7,676	644	9,692	889	13,379	1,223	18,406
Lamb & Mutton	Cwt.	18.54	27	501	30	556	42	779	59	1,094
Milk	Cwt.	2.95	611	1,802	618	1,823	847	2,499	1,169	3,449
Chickens	Lbs.	.15	760	114	680	102	920	138	1,240	186
Turkeys	Lbs.	.20	520	104	722	144	995	199	1,374	275
Eggs	Doz.	.25	2,966	742	5,164	1,291	7,116	1,779	9,866	2,467

1/ Current Normalized Price, Interim Price Standards for Planning and Evaluating Water and Land Resources, Water Resources Council, April, 1966.

2/ Pasture production reported in million feed units.

3/ Present is based upon an average of the five years 1966-1970 and data from the recently completed Missouri River Basin Comprehensive Framework (Type I) Study.

ration compositions. Projected roughage production and acreages are tied directly to these derived feed unit consumption levels. It was assumed that all pasture and range production would be utilized prior to determining roughage required in the form of silages and hay.

Feed grain production is projected to be 97 percent greater than the present production by 1980 and three times greater by 2020. Wheat, rye and soybean production levels are all more than doubled by 2020. However, the production of dry beans decreases 35 percent by 2020. Potato production decreases 41 percent by 1980 but then increases 29 percent above the present level by 2020 while sugar beet production is two and one-half times the present level by 2020. The silage production in 2020 is projected to be double the present production while hay production increases 67 percent over the same time period.

Beef and veal production increase 181 percent over the present production by 2020. The production of eggs more than triples by 2020 while pork and lamb and mutton production both are doubled. Historically, livestock and livestock products production has risen steadily except for sheep and lambs and turkeys, both of which are of relatively minor importance in the basin (Table III-18). Milk production in 1964 more than quadrupled the 1959 level. Livestock feeding has increased rapidly in the area but still only at rates comparable to the State of Nebraska.

TABLE III-18.--HISTORICAL LIVESTOCK AND LIVESTOCK PRODUCTS SOLD NIOBRARA RIVER BASIN, NEBRASKA

Commodity	Unit	1949	1954	1959	1964
		(Thousand)			
Cattle & Calves	No.	204	263	299	371
Hogs	No.	163	137	184	200
Sheep & Lambs	No.	34	40	52	36
Whole Milk	Cwt.	67	71	92	447
Chickens	No.	N.A.	186	190	188
Turkeys	No.	37	53	43	28
Eggs	Doz.	3,112	2,872	2,968	2,733

Source: U. S. Department of Commerce, Bureau of Census, Census of Agriculture.

The aggregate value of present and projected production was calculated by multiplying the production by constant prices for all four time periods. Thus increases in gross value are the result of production alone. The total value of cash crops is $13 million presently and increases to $17 million by 1980, $21 million by 2000 and $30 million by

2020. Cash crops account for about 10 percent of the aggregate value. Feed grains presently account for 11 percent and increase to 15 percent for the projected years. Corn for grain accounts for 80 percent of the present feed grain value and 89 percent of the 2020 feed grain value.

The total value of livestock and livestock production is $60 million presently and increases to $90 million by 1980, $130 million by 2000 and $158 million by 2020. Over 81 percent of this value is derived from the sale of beef and veal presently and is projected to increase to 84 percent by 2020.

The aggregate value of production in Table III-19 overestimates the gross value of agricultural production actually received by the basin's agricultural industry. The feed grains and roughage are partially consumed by the basin livestock. The gross farm income estimated in Table III-19 represents a "value added" concept and includes the value of livestock production, cash crops, exported feed grains and exported hay. The gross farm income is projected to increase from $76 million presently to $120 million by 1980, $172 million by 2000 and $217 million by 2020.

TABLE III-19.--ECONOMIC TRENDS AND IMPLICATIONS
NIOBRARA RIVER BASIN, NEBRASKA

Item	Unit	Present	1980	2000	2020
Gross Farm Income	Th.Dol.	76,146	119,500	171,814	217,453
Gross Income Per Farm	Dollars	17,700	33,400	62,500	87,000
Gross Income Per Farm Worker	Dollars	12,600	22,100	40,900	55,800

Source: Present is based upon an average of the five years 1966-1970 and data from the Missouri River Basin Comprehensive Framework Study, 1969.

Projected gross income per farm (Table III-19) is projected to be $33,400 by 1980, or 89 percent greater than the present $17,700 per farm. By 2020, the gross income per farm is projected to be nearly five times the present level. The present gross income per farm worker is estimated to be $12,600. The two factors, gross value of production and the number of farm workers, move in opposite directions to create a relatively large income per farm worker in 1980 and 2020. By 1980, gross income per farm worker is projected to be $22,100, and by 2020 it is projected to be $55,800.

The production of feed grains, silage, hay and pasture was converted to feed units and compared with the feed unit consumption of the projected livestock production (Table III-20). The Niobrara River Basin has sufficient resources to adequately support the projected livestock. Since

Table III-20.--PRESENT AND PROJECTED LIVESTOCK FEED UNIT CONSUMPTION AND FEED UNIT PRODUCTION, NIOBRARA RIVER BASIN, NEBRASKA

Commodity	Present		1980		2000		2020	
	Feed Grain	Roughage	Feed Grain	Roughage	Feed Grain	Roughage	Feed Grain	Roughage
	(Thousand Feed Units)							
Beef & Veal	276.8	2,306.9	523.3	2,874.8	508.0	3,798.8	422.7	4,210.5
Pork	190.8	6.6	240.3	0	289.4	0	313.7	0
Lamb & Mutton	10.2	30.8	10.0	31.9	11.6	32.6	12.8	37.1
Milk	23.1	59.9	24.1	52.2	17.8	63.5	16.8	74.8
Chickens	1.2	0	1.0	0	1.3	0	1.7	0
Turkeys	1.4	0	1.8	0	2.3	0	2.8	0
Eggs	11.1	0	18.1	0	23.1	0	28.5	0
Total Consumption	514.6	2,404.2	818.6	2,958.9	853.5	3,894.9	799.0	4,322.4
Projected Production	728.0	2,712.8	1,437.6	3,210.2	1,854.7	4,000.0	2,207.1	4,419.8
Difference	213.4	308.6	619.0	251.3	1,001.2	105.1	1,408.1	97.4

Source: Present is based upon an average of the five years 1966-1970 and data from the Missouri River Basin Comprehensive Framework Study, 1969.

roughage production levels were directly related to livestock production, the excess roughage is very minimal. A small amount of hay is also available for export presently and in the projected years. Corn is the major feed grain available for export. Alternatively, the export of feed grain could be reduced by increased cattle feeding in the basin or idling a large share of the projected irrigated acreage. A level of projected production significantly above the historic and present share of national feed grain requirements would be at the expense of other feed producing areas in Nebraska or elsewhere in the United States.

Vast Sand-Hill Range Supports Cow-Calf Herds

The range-livestock industry has long been the major source of income in the basin. The income has been supplemented by cash crops such as wheat, potatoes, dry beans and sugar beets and by exports of feed grains and native hay. A relative increase in the value of livestock production may occur with increased livestock feeding due to increased feed grain production in the basin. Labor forces, population centers, markets, processing plant location, and transportation rates for feed and livestock all determine regional prices which, in turn, create regional advantages or disadvantages and influence levels of livestock production.

The level of projected agricultural production may be considered as that which might be expected if past trends continue. Since projections of yields based on historical trends were used, a certain amount of resource development is "built-in" to the system. Better management techniques, such as higher levels of fertility and soil conservation practices, are inherent factors in the projections. Resource development practices that will be applied in the future, such as land treatment and water conservation measures which sustain the quality of the resource are implicit in the projections of agricultural production. In addition, major projects enhancing the capability of the resources, accelerating existing programs, or changing traditional patterns will tend to create a source of added production.

Realization of the projected agricultural production will require additional inputs, especially seed, herbicides and fertilizer. The costs of seed, herbicides and insecticides are a significant percentage of the crop budget but are not likely to increase greatly in the future. Fertilizer use per acre has been increasing. The projected levels of production will increase total fertilizer usage. However, nutrient requirements per unit of production are projected to decrease from present requirement levels.

D. Forest Resources and Related Economic Activity

The forests of the Niobrara River Basin had a profound influence on the basin's early settlement and development and still contribute to its economy, welfare, recreation, wildlife, scenic beauty, and environmental quality.

There are 119,200 acres of privately-owned forest lands in the basin. Of this acreage, about 115,000 acres is commercial forest land which is at least 10 percent stocked by trees of any size and species, and producing, or physically capable of producing, commercially usable wood or other forest products. The Niobrara Basin is one of the few basins in which both the eastern hardwood species and western softwoods species are native. In general, the native forests occur in the moist bottomlands along streams and rivers and on sheltered slopes. The principal tree species are cottonwood, elm, ash, oak, ponderosa pine, and eastern red cedar. There are also some hackberry, black walnut, and hickory, but these have become quite scarce. Cottonwood is the predominant and most widely distributed species. The average value of this timber in the standing trees is about $10.00 per thousand board feet

for the lower-value species of cottonwood, elm and ash and about $250.00 per thousand board feet for the most valuable but scarce black walnut.

Grazing of forest land is widespead in the basin. About 105,000 acres, or 88 percent of the private forest land is grazed by livestock; 50 percent of this area is classed as heavily grazed. The economic benefit from grazing the forest land is low. The return from this land use is included in the overall-values of livestock production.

Sawtimber volumes on private commercial forest land total about 108 million board feet and the growing stock trees total about 30 million board feet. The commercial sawtimber volume per acre is about 1,300 cubic feet. About 80 percent of the commercial timber volume is in hardwoods in the eastern portion of the basin, and consists mainly of cottonwood, elm, ash and oak with some black walnut and other hardwood trees. The ponderosa pine type is predominant in the western part of the basin.

The sawtimber cut averages about 1.5 million board feet annually. The sawmill output value for the timber products amounts to about $200,000 annually. The current annual growth is about 3.5 times the annual cut. However, the quality of timber supplies and occurrance of desirable species is decreasing. Valuable species such as black walnut and hackberry are being overcut. Timber harvest is expected to continue at about the present level although it would be desirable to increase the rate of timber cutting especially in the lower value species such as cottonwood and elm.

The average merchantable timber volumes are far below those needed to induce major forest-based industrial development. Volumes are sufficient to support post and pole operations and an increase in small sawmill operations. The greatest potential is for local custom sawing to provide off-peak season work for farm labor. At the present time a number of such operations exist in the basin. A post and pole operation located west of Springview, Nebraska treats 20,000 to 30,000 posts annually using the pentachlorphenol cold soak method. Two small active sawmills of one to five thousand board feet capacity are operating in the Coleman Creek drainage. Five other small sawmills, each with an annual capacity of one to ten million board feet, operate part-time filling custom orders. Three are located in Knox County and there is one in both Holt County and Keya Paha County.

In addition to the timber products, other benefits are derived from the forest areas. Forests and woodlands contribute to the beautiful terrain and abundant wildlife of the basin in addition to providing watershed protection. Many recreation opportunities occur in the basin and more facilities could be developed. At present only a few developments have been provided. Recreation is a fast growing industry and developments in forested areas could bring significant financial returns to the landowners.

The Samuel R. McKelvie National Forest contains 115,716 acres of federal land in Cherry County located between the Snake and Niobrara

Rivers. About 300 acres of the Pine Ridge Division of the Nebraska National Forest is also included in the basin. These lands are managed through the practice of multiple use for a variety of products, resources, and public enjoyments including recreation and hunting. There are 113,000 acres within grazing allotments on which livestock owned by local ranchers are grazed under permit. The economic returns to the ranchers and community are included in the overall livestock production benefits for the basin. About 13,000 acres have been planted to ponderosa pine, jack pine and other tree species as part of Nebraska's man-made forest. Fence posts, poles, pulp and fuel wood are being harvested from this forest acreage. Under multiple use management approximately 9,000 acres are given special attention in relationship to the Merritt Reservoir and another 1,000 acres along the Snake River as having potential for inclusion in the Wild, Scenic and Recreation Rivers System as part of the Niobrara River. Developments and improvements of wildlife habitat are provided. The entire 115,716 acres are available for public hunting and recreation.

E. Outdoor Recreation and Related Economic Activity

The Niobrara River Basin provides much opportunity for outdoor recreation, and fish and wildlife activities. However, the economic value of this activity is relatively minor in comparison to other economic activity in the basin. Income from visitors to the basin provides a significant share of the total since the basin's population is relatively sparse. Recreational activity creates expenditures for lodging, groceries, auto fuel and parts, and meals. Duck, prairie chicken, grouse, pheasant, turkey, deer and antelope hunting create economic activity through the sale of hunting licenses, shells, guns, archery equipment and other related hunting equipment and clothes.

The numerous natural lakes and wetlands are excellent for duck production and serve as resting areas along the duck migration routes. Wild turkeys were introduced into the area in the early 1960's and have become established to the points where hunting is possible. Antelope have also been reintroduced into the Sandhills area.

Fishing also creates economic activity in the basin through the purchase of equipment and supplies. Bait sales provide some seasonal supplemental income to individuals. Tributary streams throughout the length of the Niobrara River Basin supports a cold water fishery while other streams, lakes and reservoirs support warm water fish.

Within the basin, there is one state refuge on the Niobrara River. Two National Wildlife refuges, the Fort Niobrara National Wildlife and the Valentine National Wildlife Area lie within the basin. In addition, four areas are designated as public hunting areas.

Most of the larger towns have municipal swimming pools which meet much of the needs of the basin for swimming. Nearly all towns have parks for public use which meet picnicking needs and provide opportunities for

various other outdoor activities. Water skiing is possible on both Box Butte and Merritt Reservoirs. Canoeing, boating and rafting are done on the Niobrara River.

Farmers and ranchers in the basin obtain some supplemental income from recreation activities. The recreational income includes gross cash receipts obtained from fees for the privilege of hunting and fishing. However, recreational income is still an insignificant source of income. In the 1964 Census of Agriculture, 43 farms reported receiving recreational income, the average value being nearly $200 per farm. However, this is not a full measure of the agricultural contribution to recreation because many farmers ask only that permission be obtained and do not charge any fees.

The characteristics of an area's population affect the demand for recreational activities. A rural to urban realignment of the population is occurring. Projections indicate that the farm population will continue to decrease and the urban population will continue to increase. The median age of the people in the basin is 30.6 years compared to 30.2 years for the State of Nebraska. The percent of people 65 and older has consistently increased for the 70 years of the census periods. The 65 and older category consists mostly of retired people who have considerable leisure time but are not physically active. This is countered by a significant increase in numbers of those 14 and under who require specialized facilities and relatively close supervision. Those under 14 and over 65 make up 42 percent of Nebraska's population.

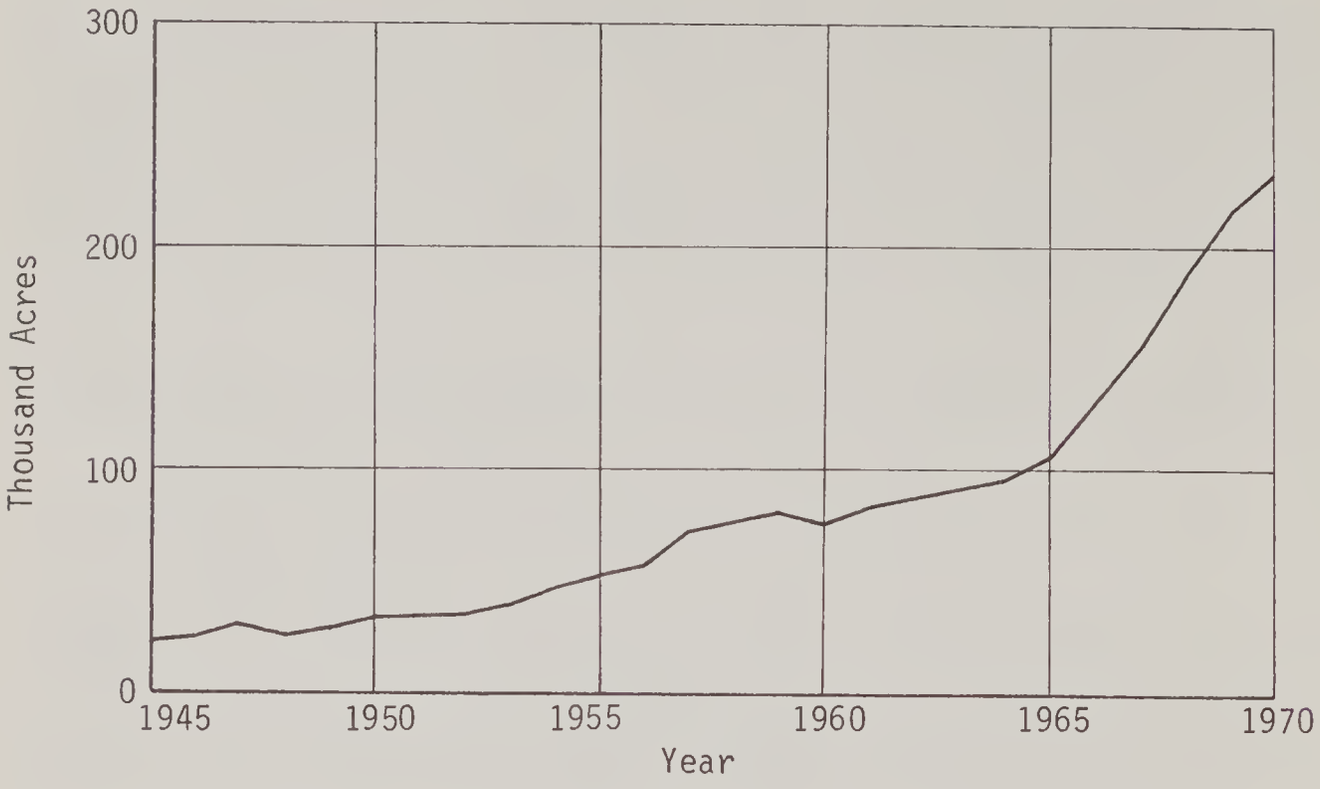
Other factors which may lead to an increased future economic activity in recreation include increasing educational and family income levels. The population is also becoming more mobile. Mechanization and improved technology along with a shorter work week will result in more leisure time.

F. Relationship of Economic Development and Water Resource Development

Water resource development has not been widespread in the Niobrara Basin, but it has been important in some local areas. The first project type irrigation was the Mirage Flats Irrigation Project which began operation in 1946. Ground water irrigation began in Box Butte County in 1938 and, in recent years, the eastern portion of the basin has had a large increase in ground water irrigation. The total area irrigated in eight counties[1/] approximating the basin has increased from 22,000 acres in 1945 to 234,200 acres in 1970 (Figure III-6). It should be noted that the eight county irrigated acreage is considerably larger than the irrigated acreage of the Niobrara River hydrologic area. Although not

1/ Box Butte, Boyd, Brown, Cherry, Holt, Keya Paha, Rock, and Sheridan Counties.

FIGURE III-6.--IRRIGATION ACREAGE INCREASES
NIOBRARA RIVER BASIN, NEBRASKA



in agreement with the hydrologic area, the eight county data does allow presentation of the historical trend of irrigation in the general area of the Niobrara River Basin. The historical trend is only available on the county basis. New irrigation has often resulted in a shift from either rangeland or hayland to irrigated corn and alfalfa. Consequently, there is an increasing use of fertilizers and chemicals in the area and an increasing need for more grain storage capacity.

Urban and rural communities provide services for the agriculture industry. Agriculture related businesses may need to expand in volume either by increasing the number of firms or by expanding the size of present firms. Local elevators may need to increase in capacity to handle increased volumes of grains. Fertilizer and commercial feed requirements will increase thus providing the need for dealers to handle these products. It is likely that the demand for agriculture related products will be met by an expansion of existing firms.

IV. WATER AND RELATED LAND RESOURCE PROBLEMS

Water and land resource problems are identified which adversely affect the basin. Analyses of problems describe causes, extents and frequencies, and social and economic consequences. Analyses, when possible, are in physical and monetary terms. Other problems are identified and analyzed whose solutions would result in economic growth, increased production efficiency, or general enhancement of the physical environment.

A. Floodwater and Sediment Damages

The physical characteristics of the basin are not conducive to the generation of large flood flows. The generally narrow floodplains, absence of towns and farmsteads in the floodplains, and utilization of floodplain lands largely for pasture and hay production lessens the occurrence of severe damage in the event of floods. Flood damages have been most severe in the reach immediately above the mouth of the Niobrara River. It is estimated that about 130,700 acres are subject to flooding. The area damaged in each delineated watershed is shown in Table IV-1. A watershed delineation map showing the location of each watershed is shown in Figure IV-1.

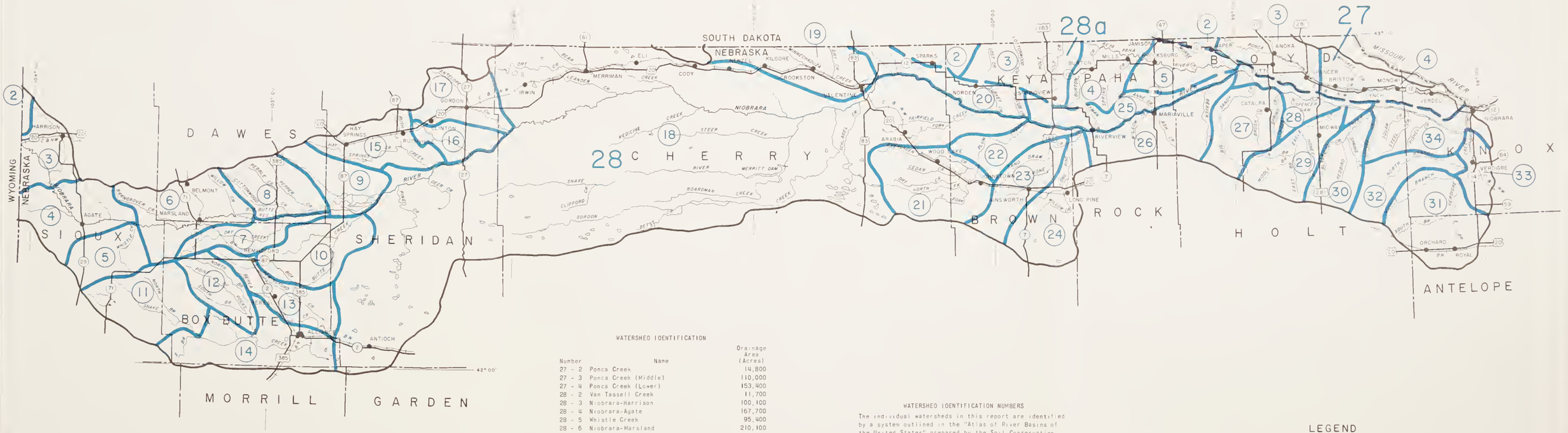
Floods are most likely to occur during the period of snowmelt and ice breakup in the early spring and during the period of normally heaviest precipitation during the spring and early summer, but may occur later in the year, particularly on tributary streams. General floods are comparatively rare. While flooding to some extent has undoubtedly occurred at some time on most of the tributaries, actual evidence of damaging floods can be found for only a few of the streams.

The federal and state highway bridges are all of substantial steel or concrete construction and usually not subject to damage by floods. Most county bridges are generally of light steel truss construction, and these bridges and their approaches have suffered from past floods, constituting a major item of flood damage. Damages to bridges, culverts and roadbed fills are the most frequent types of damage to railroad facilities.

The Niobrara River carries a moderate load of coarse suspended sediment and a relatively heavy load of comparatively fine bed sediment. The estimated average suspended-sediment discharge at Meadville (about 100 miles above the mouth of the Niobrara River) is 2,328,000 tons per year. The bed load, at 30 percent of the suspended-sediment, is about 700,000 tons at Meadville. Downstream from Meadville, the estimated yield per square mile of drainage is 500 to 1,000 tons. The total sediment discharge at the mouth of the Niobrara into Lewis and Clark Lake is estimated by the Corps of Engineers1/ to be 2,900,000 tons per year.

Table IV-1.--SUMMARY OF WATER AND RELATED LAND RESOURCES PROBLEMS AND NEEDS
NIOBRARA RIVER BASIN, NEBRASKA

Delineated Watershed Identification			Floodwater & Sediment		Gully Erosion			Agric. Water Mgmt. Drainage	
Number	Name	Drainage Area	Area Having Problem	Area Needing Project Action	Area Having Problem	Area Needing Project Action		Area Having Problem	Area Needing Project Action
		(Acres)							
28 - 2	Von Tassell Creek	11,700	0	0	0	0		0	0
28 - 3	Niobrara-Harrison	100,100	1,250	1,250	10,000	0		0	0
28 - 4	Niobrara-Agate	167,700	2,550	2,550	24,000	0		0	0
28 - 5	Whistle Creek	95,400	600	600	8,000	0		0	0
28 - 6	Niobrara-Marsland	210,100	4,550	4,550	42,000	0		10,000	0
28 - 7	Sand Creek	75,400	1,750	750	3,000	0		500	0
28 - 8	Dunlap Tribs	125,800	5,100	4,100	20,000	0		1,000	0
28 - 9	Mirage Flats	114,900	4,750	3,350	33,000	0		1,500	0
28 -10	Box Butte Creek	158,700	1,850	1,850	7,000	0		2,200	0
28 -11	Snake Creek (Upper)	184,300	500	500	1,000	0		500	0
28 -12	Point of Rocks Creek	95,500	1,000	1,000	5,000	0		2,500	0
28 -13	Berea-Hemingford Creeks	117,200	1,500	1,500	1,500	0		4,500	3,000
28 -14	Snake Creek (Lower)	218,400	2,000	2,000	2,000	0		6,000	4,000
28 -15	Rush Creek	142,900	5,100	5,100	12,500	0		1,000	0
28 -16	Niobrara-Sheridan Tribs	75,700	1,150	400	18,000	0		300	0
28 -17	Antelope Creek	107,000	2,300	2,300	15,000	0		2,000	0
28 -18	Niobrara Sandhills	2,648,200	26,400	7,200	32,000	0		80,000	80,000
28 -19	Minnechaduza Creek	162,300	1,150	1,150	15,000	0		1,000	0
28 -20	Niobrara Tribs (Cherry-Keya Paha)	118,600	2,750	1,000	23,000	0		0	0
28 -21	Plum Creek (Upper)	200,600	1,400	1,400	2,250	0		10,000	10,000
28 -22	Plum Creek (Lower)	90,400	1,800	600	15,000	0		2,000	2,000
28 -23	Bone Creek	126,800	600	600	30,000	0		6,000	6,000
28 -24	Long Pine Creek	166,300	450	450	17,000	0		2,500	1,500
28 -25	Riverview Tribs	106,700	4,800	200	15,000	0		300	0
28 -26	Mariaville Tribs	179,000	4,400	900	13,500	0		2,000	0
28 -27	Big Sandy-Brush Creek	142,600	3,450	2,550	50,000	0		500	0
28 -28	Turkey Creek Tribs	77,700	4,200	150	6,800	0		100	0
28 -29	Eagle Creek	132,300	3,200	3,200	50,000	0		4,000	4,000
28 -30	Redbird Creek	104,100	2,650	2,650	50,000	0		3,000	2,000
28 -31	Verdigre Creek (Upper)	207,200	5,900	5,900	75,000	0		0	0
28 -32	North Branch Verdigre Cr.	93,400	1,050	1,050	21,400	0		2,500	1,500
28 -33	Verdigre Creek (Lower)	53,800	3,000	3,000	16,000	0		200	0
28 -34	Niobrara River (Lower)	137,400	10,300	2,200	71,200	0		2,700	2,000
28a- 2	Sandy Shady Creek	47,400	0	0	0	0		1,000	0
28a- 3	Lost Half	142,800	900	900	1,000	0		0	0
28a- 4	Burton-Spring	121,500	2,350	600	15,000	0		0	0
28a- 5	Keya Paha Tribs (Lower)	106,500	5,500	500	6,000	0		400	0
27 - 2	Ponca Creek	14,800	650	650	1,000	0		200	0
27 - 3	Ponca Creek (Middle)	110,000	6,900	6,900	16,000	4,500		1,000	0
27 - 4	Ponca Creek (Lower)	153,400	950	950	33,600	4,500		3,500	3,000
	TOTAL	7,444,600	130,700	76,500	777,750	9,000		145,900	119,000



WATERSHED IDENTIFICATION

Number	Name	Drainage Area (Acres)
27 - 2	Ponca Creek	14,800
27 - 3	Ponca Creek (Middle)	110,000
27 - 4	Ponca Creek (Lower)	153,400
28 - 2	Van Tassell Creek	11,700
28 - 3	Niobrara-Harrison	100,100
28 - 4	Niobrara-Agate	167,700
28 - 5	Whistle Creek	95,400
28 - 6	Niobrara-Marsland	210,100
28 - 7	Sand Creek	75,400
28 - 8	Dunlap Trib s	125,800
28 - 9	Mirage Flats	114,900
28 -10	Box Butte Creek	158,700
28 -11	Upper Snake Creek	184,300
28 -12	Point of Rocks Creek	95,500
28 -13	Berea-Hemingford Creeks	117,200
28 -14	Lower Snake Creek	218,400
28 -15	Rush Creek	142,900
28 -16	Niobrara-Sheridan Tribs	75,700
28 -17	Antelope Creek	107,000
28 -18	Niobrara Sand Hills	2,648,200
28 -19	Minnechaduza Creek	162,300
28 -20	Niobrara Tribs - (Cherry-Keya Paha)	118,600
28 -21	Upper Plum Creek	200,600
28 -22	Lower Plum Creek	90,400
28 -23	Bone Creek	126,800
28 -24	Long Pine Creek	166,300
28 -25	Riverview Tribs	106,700
28 -26	Mariaville Tribs	179,000
28 -27	Big Sandy-Brush Creek	142,600
28 -28	Turkey Creek Tribs	77,700
28 -29	Eagle Creek	132,300
28 -30	Redbird Creek	104,100
28 -31	Upper Verdigre Creek	207,200
28 -32	North Branch Verdigre Creek	93,400
28 -33	Lower Verdigre Creek	53,800
28 -34	Lower Niobrara River	137,400
28a- 2	Sandy Shady Creek	47,400
28a- 3	Lost-Holt	142,800
28a- 4	Burton-Spring	121,500
28a- 5	Lower Keya Paha Tribs	106,500
		7,444,600

WATERSHED IDENTIFICATION NUMBERS

The individual watersheds in this report are identified by a system outlined in the "Atlas of River Basins of the United States" prepared by the Soil Conservation Service, in June 1970. The Atlas provides specific identification for each subbasin having a drainage area greater than 700 square miles. The National Inventory of Soil and Water Conservation Needs provided specific instructions for the delineation of the subbasin areas into watersheds less than 250,000 acres, except for the Sandhills area where it is known that there is no potential for watershed development. Each delineated watershed was assigned a numerical designation beginning in the upper portion of the subbasin and proceeding downstream.

The complete identification code developed for each delineated watershed consists of five parts, (a) the state, (b) major drainage area, (c) principal drainage basin, (d) subbasin, and (e) the numerical designation of the delineated watershed. For example, Upper Verdigre Creek Watershed has a complete watershed identification number of Neb-MR-Niobrara-28-31. In this report only (d) and (e), the subbasin and the watershed numbers, are shown.

The three subbasins in this report are 28-Niobrara River, 28a-Keya Paha River, and 27-Ponca Creek. The numerical designation of the delineated watersheds are shown in the watershed identification list.

LEGEND

- SUBBASIN DRAINAGE AREA OF MORE THAN 700 SQUARE MILES
- 28 — SUBBASIN IDENTIFICATION NUMBER (ATLAS OF RIVER BASINS, JUNE 1970)
- WATERSHED AREAS OF LESS THAN 250,000 ACRES
- (5) — WATERSHED NUMBER WITHIN SUBBASIN

FIGURE IV-1

WATERSHED DELINEATION MAP

NIOBRARA RIVER BASIN

NEBRASKA

SCALE 10 0 10 20 30 40 MILES

SCALE 1/1,207,000

SOURCE
SCS DRAWING 5,S-28978 AND INFORMATION FROM SCS FIELD TECHNICIANS.

LAMBERT CONFORMAL CONIC PROJECTION

1504-SCS-LINCOLN, NEB. 1972

3-21-72
5,S-30066

The sediment load appreciably affects the natural stream channel only in the lowermost reach. This sediment load is largely responsible for the flood-related sediment problems in Lewis and Clark Lake formed by Gavins Point Dam. Prior to completion of the dam, sediment deposits which formed at the mouth of the Niobrara River were periodically flushed away by high flows on the Missouri River. With the Missouri River controlled, deposits at the mouth have accumulated, causing aggradation of the lower reach of the Niobrara River. The deposits have caused frequent flooding at the Niobrara State Park near the mouth and have increased the flood hazard to rural development in the lower reach and to urban-related development near the town of Niobrara. Sediment deposition on cultivated floodplains in some areas causes considerable crop damage and loss. Deposition of sediment forms levees along streambanks and subsequently disrupts the functioning and maintenance of natural drainage systems.

Other agricultural damage includes floodwater and sediment damage to fences, harvested crops, machinery, and livestock. Farmsteads and lots are generally located above the floodplain and therefore are usually free of flood damage. Loss of stacked hay has often been of considerable magnitude. Fence damage not only includes the replacement cost and labor but also the expense of recovering the strayed animals and the damage done by them to crops.

Current average annual floodwater and sediment damages for the upstream area of 76,500 acres are estimated to total $308,120. This includes $176,550 crop and pasture damages, $30,050 of other agricultural damages, $89,030 of rural nonagricultural damages, and $12,490 of urban damages. A detailed listing of these damages for each of the delineated watersheds is shown in Table IV-2. The floodplain areas along the main stem of the Niobrara River below Box Butte reservoir and along the main stem of the Keya Paha River below the state line are not included in Table IV-2. These areas -- 44,000 acres on Niobrara River and 3,000 acres on Keya Paha River -- were evaluated by the Corps of Engineers as having an average annual flood damage of $62,000. This includes $36,000 crop and pasture damages and $26,000 as other rural agricultural and nonagricultural damages.

In addition to the direct damages discussed above, other losses stem from flooding even though the area or property may not have been flooded. Examples of such damage consist of interruptions to travel, temporarily deterring persons, temporary dislocation of persons from work, extra time and travel required for delivering farm products, interrupted mail and delivery schedules, and disruption and damage to utility systems. These other losses are estimated to be about $30,000 annually.

B. Erosion Damages

The basin is located in the Western Great Plains Range and Irrigated and Central Feed Grains and Livestock Land Resource Regions.

1/ Corps of Engineers, Department of Army, Design Memo No. MG-91, Relocation of Niobrara, Nebraska June 1970

Table IV-2.--SUMMARY OF RESIDUAL FLOODWATER AND SEDIMENT DAMAGES
NIOBRARA RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Drainage Area	Area Needing Project Action	Floodwater & Sediment - Average Annual Damage Under Current Economic Development				
Number	Name			Crop and Pasture	Other Agri.	Rural Non-Ag.	Urban	Total Direct
		(Acres)	(Acres)	(Dollars)				
28 - 2	Van Tassell Creek	11,700	0	0	0	0	0	0
28 - 3	Niobrara-Harrison	100,100	1,250	680	120	300	0	1,100
28 - 4	Niobrara-Agate	167,700	2,550	1,500	200	400	0	2,100
28 - 5	Whistle Creek	95,400	600	350	150	100	0	600
28 - 6	Niobrara-Marsland	210,100	4,550	3,220	230	1,100	0	4,550
28 - 7	Sand Creek	75,400	750	1,700	300	300	0	2,300
28 - 8	Dunlap Tribs	125,800	4,100	4,300	500	1,050	0	5,850
28 - 9	Mirage Flats	114,900	3,350	21,100	2,500	3,900	0	27,500
28 -10	Box Butte Creek	158,700	1,850	2,550	500	750	0	3,800
28 -11	Snake Creek (Upper)	184,300	500	600	200	100	0	900
28 -12	Point of Rocks Creek	95,500	1,000	1,200	400	1,500	0	3,100
28 -13	Berea-Hemingford Creeks	117,200	1,500	3,300	700	3,000	0	7,000
28 -14	Snake Creek (Lower)	218,400	2,000	3,100	500	600	800	5,000
28 -15	Rush Creek	142,900	5,100	5,250	500	1,900	2,000	9,650
28 -16	Niobrara-Sheridan Tribs	75,700	400	450	100	450	0	1,000
28 -17	Antelope Creek	107,000	2,300	150	100	180	2,290	2,720
28 -18	Niobrara Sandhills	2,648,200	7,200	8,000	2,000	3,500	1,000	14,500
28 -19	Minnechaduza Creek	162,300	1,150	1,350	500	1,500	0	3,350
28 -20	Niobrara Tribs (Cherry-Keya Paha)	118,600	1,000	2,300	500	1,200	0	4,000
28 -21	Plum Creek (Upper)	200,600	1,400	900	500	700	0	2,100
28 -22	Plum Creek (Lower)	90,400	600	500	400	200	0	1,100
28 -23	Bone Creek	126,800	600	1,150	500	1,050	400	3,100
28 -24	Long Pine Creek	166,300	450	800	500	800	0	2,100
28 -25	Riverview Tribs	106,700	200	700	700	1,000	0	2,400
28 -26	Mariaville Tribs	179,000	900	2,100	1,000	1,400	0	4,500
28 -27	Big Sandy Brush Creek	142,600	2,550	5,600	500	1,600	0	7,700
28 -28	Turkey Creek Tribs	77,700	150	600	500	300	0	1,400
28 -29	Eagle Creek	132,300	3,200	12,000	1,000	4,200	0	17,200
28 -30	Redbird Creek	104,100	2,650	8,300	1,000	3,600	0	12,900
28 -31	Verdigre Creek (Upper)	207,200	5,900	18,700	2,000	10,500	0	31,200
28 -32	North Branch Verdigre Cr.	93,400	1,050	3,100	500	1,400	0	5,000
28 -33	Verdigre Creek (Lower)	53,800	3,000	12,100	1,000	7,900	6,000	27,000
28 -34	Niobrara River (Lower)	137,400	2,200	7,600	500	2,600	0	10,700
28a- 2	Sandy Shady Creek	47,400	0	0	0	0	0	0
28a- 3	Lost-Holt	142,800	900	1,950	300	450	0	2,700
28a- 4	Burton-Spring	121,500	600	1,100	300	450	0	1,850
28a- 5	Keya Paha Tribs (Lower)	106,500	500	950	400	700	0	2,050
27 - 2	Ponca Creek	14,800	650	2,900	650	2,200	0	5,750
27 - 3	Ponca Creek (Middle)	110,000	6,900	30,350	6,900	23,050	0	60,300
27 - 4	Ponca Creek (Lower)	153,400	950	4,050	900	3,100	0	8,050
	TOTAL	7,444,600	76,500	176,550	30,050	89,030	12,490	308,120

Cattle raising and crop production are the principal industries in the predominantly agricultural basin. About 83 percent of the basin is utilized for grazing.

Sheet erosion has caused the gradual removal of the more highly productive top soils and has exposed the undeveloped and less productive parent materials. The loss of top soil has resulted in reduced productivity. Sheet erosion generally is a problem on all soils, but especially on sloping soils, and on soils devoted to cultivated crops.

Wind erosion is a problem where top soils are sandy or are of very light texture. "Blow outs" occur in the Sandhills when range cover deteriorates because of overgrazing. Generally, wind erosion is a problem in this basin during drought years when plant cover is inadequate.

The tableland soils are generally very fine sandy loams or silty loams. Both are dry farmed to some extent for a variety of crops but the sandy loams are generally devoted to grazing and production of hay. Much of the acreage devoted to introduced grasses are severely overgrazed and erosion is a severe problem in much of the area. The soils of the Sandhill region are of sandy texture and low humus content and are susceptible to wind erosion when broken. Sandhill soils absorb water quickly, and water erosion is not usually a severe hazard.

The 1967 Conservation Needs Inventory shows that 5,777,700 acres of land have an erosion problem. It is estimated that 1,000,200 acres of this erosion problem are located on cropland, 40,300 acres of which are irrigated. There are 4,670,600 acres of pasture and range subject to erosion, with an additional 76,300 acres of forest and 30,700 acres of other agricultural land having an erosion problem. Table IV-3 is an inventory, by land capability units, of the agricultural land having an erosion problem.

TABLE IV-3.--INVENTORY OF AGRICULTURAL LAND WITH EROSION PROBLEMS BY LAND CAPABILITY UNITS, NIOBRARA RIVER BASIN, NEBRASKA 1/

Item	Land Capability Unit					
	II E	III E	IV E	VI E	VII E	Total
	(Thousand Acres)					
Cropland	330.8	415.2	207.3	46.9	(0)	1,000.2
Irrigated	(13.2)	(19.7)	(7.4)	(0)	(0)	(40.3)
Non-Irrigated	(317.6)	(395.5)	(199.9)	(46.9)	(0)	(959.9)
Pasture & Range	163.7	585.5	660.7	2,326.3	934.4	4,670.6
Irrigated	(5.6)	(1.3)	(0)	(0)	(0)	(6.9)
Non-Irrigated	(158.1)	(584.2)	(660.7)	(2,326.3)	(934.4)	(4,663.7)
Forest	4.2	19.8	1.9	48.2	2.2	76.3
Other	7.3	10.5	5.9	7.0	0	30.7
TOTAL	505.9	1,031.0	875.8	2,428.4	936.6	5,777.7

1/ From 1967 Conservation Needs Inventory

About 141 miles of streambank are affected by erosion, but there is little evidence of serious damage. Instances of active erosion are infrequent and widely scattered, and very little streambank erosion occurs beyond the normal low water channels. Damage is considered serious on only about 15 miles, with current average annual damages estimated to be $63,600. These damages include loss of land, deposition of infertile sediment, and other damages.

Gully erosion is accelerated by the lack of vegetative cover and is ordinarily most severe in cultivated areas on rolling topography. Land damage from gullying on irrigated lands is usually associated with and accentuated by irrigation water return flows. The watershed projects section of the 1967 Conservation Needs Inventory reports that about 777,750 acres in the basin have a gully erosion problem. Not all of this area has gully problems that are of the size and nature that need treatment by project type action. In this study, it was estimated that 768,750 acres could be treated with land treatment measures by individual landowners or operators with the remaining 9,000 acres requiring project development. The problem area and the area needing project action for each of the delineated watershed is shown in Table IV-1.

Monetary damages from gully erosion have been estimated for each of the delineated watersheds. Average annual damage under current economic development is estimated to be $235,000. Of this total, $185,300 is agricultural damage, and the remaining $49,700 is non-agricultural damage. Table IV-4 lists the summary of current gully erosion damages for each of the delineated watersheds in the basin.

C. Impaired Drainage

An analysis of the 1967 Conservation Needs Inventory shows that approximately 325,300 acres of agricultural land, or about four percent of the basin, are designated as soils having excess water problems (see Table IV-5). Approximately 19,600 acres of this area are presently in cropland, 277,900 acres are in pasture and range, 14,200 acres are in forest, and 13,600 acres are located on other land.

A major portion of the soils classed as having a wetness problem are located in the Sandhills area where they are presently being used as subirrigated hay meadows and pasture. These soils are characterized by high water tables which would be a problem only if these soils were cropped.

In addition to the wetness problems in the Sandhills area, there are areas on the floodplains of the Niobrara River and Ponca Creek having wetness problems. In these areas there are bottomland soils with slow internal drainage and inadequate surface drainage, causing water table conditions that have a detrimental effect on agricultural production. Crops normally grown in the area are subjected to delayed plantings, additional farming operations, and untimely harvests which reduce yields, lower quality, and increase production costs. In some areas, if the impaired drainage conditions are not corrected, it may be

Table IV-4.--SUMMARY OF CURRENT GULLY EROSION DAMAGES
NIOBRARA RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Drainage Area	Area Having Problem	Average Annual Damage Under Current Economic Development		
Number	Name			Agri-cultural	Non-Agri-cultural	Total Direct
		(Acres)	(Acres)	(Dollars)		
28 - 2	Van Tassell Creek	11,700	0	0	0	0
28 - 3	Niobrara-Harrison	100,100	10,000	2,300	700	3,000
28 - 4	Niobrara-Agate	167,700	24,000	5,500	1,600	7,100
28 - 5	Whistle Creek	95,400	8,000	1,800	500	2,300
28 - 6	Niobrara- Marsland	210,100	42,000	9,700	2,800	12,500
28 - 7	Sand Creek	75,400	3,000	700	200	900
28 - 8	Dunlap Tribs	125,800	20,000	4,600	1,300	5,900
28 - 9	Mirage Flats	114,900	33,000	7,600	2,200	9,800
28 -10	Box Butte Creek	158,700	7,000	1,600	500	2,100
28 -11	Snake Creek (Upper)	184,300	1,000	200	100	300
28 -12	Point of Rocks Creek	95,500	5,000	1,200	300	1,500
28 -13	Berea-Hemingford Creeks	117,200	1,500	300	100	400
28 -14	Snake Creek (Lower)	218,400	2,000	500	200	700
28 -15	Rush Creek	142,900	12,500	2,900	800	3,700
28 -16	Niobrara-Sheridan Tribs	75,700	18,000	4,100	1,200	5,300
28 -17	Antelope Creek	107,000	15,000	3,500	1,000	4,500
28 -18	Niobrara Sandhills	2,648,200	32,000	7,400	2,100	9,500
28 -19	Minnechaduza Creek	162,300	15,000	3,500	1,000	4,500
28 -20	Niobrara Tribs (Cherry-Keya Paha)	118,600	23,000	5,300	1,500	6,800
28 -21	Plum Creek (Upper)	200,600	2,250	500	100	600
28 -22	Plum Creek (Lower)	90,400	15,000	3,500	1,000	4,500
28 -23	Bone Creek	126,800	30,000	6,900	2,000	8,900
28 -24	Long Pine Creek	166,300	17,000	3,900	1,100	5,000
28 -25	Riverview Tribs	106,700	15,000	3,500	1,000	4,500
28 -26	Mariaville Tribs	179,000	13,500	3,100	900	4,000
28 -27	Big Sandy Brush Creek	142,600	50,000	11,500	3,300	14,800
28 -28	Turkey Creek Tribs	77,700	6,800	1,600	500	2,100
28 -29	Eagle Creek	132,300	50,000	11,500	3,300	14,800
28 -30	Redbird Creek	104,100	50,000	11,500	3,300	14,800
28 -31	Verdigre Creek (Upper)	207,200	75,000	17,300	5,000	22,300
28 -32	North Branch Verdigre Cr.	93,400	21,400	4,900	1,400	6,300
28 -33	Verdigre Creek (Lower)	53,800	16,000	3,700	1,100	4,800
28 -34	Niobrara River (Lower)	137,400	71,200	16,400	4,700	21,100
28a- 2	Sandy Shady Creek	47,400	0	0	0	0
28a- 3	Lost-Holt	142,800	1,000	200	100	300
28a- 4	Burton-Spring	121,500	15,000	3,500	1,000	4,500
28a- 5	Keya Paha Tribs (Lower)	106,500	6,000	1,400	400	1,800
27 - 2	Ponca Creek	14,800	1,000	200	100	300
27 - 3	Ponca Creek (Middle)	110,000	16,000	6,800	500	7,300
27 - 4	Ponca Creek (Lower)	153,400	33,600	10,700	800	11,500
	TOTAL	7,444,600	777,750	185,300	49,700	235,000

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TABLE IV-5.-- INVENTORY OF AGRICULTURAL LAND WITH EXCESS WATER PROBLEMS, BY LAND CAPABILITY UNITS, NIOBRARA RIVER BASIN, NEBRASKA

Item	Land Capability Unit						Total
	IIW	IIIW	IVW	VW	VIW	VIIIW	
	(Thousand Acres)						
Cropland	7.6	5.6	-	1.1	5.3	-	19.6
Irrigated	(0.4)	(-)	(-)	(-)	(-)	(-)	(0.4)
Non-Irrigated	(7.2)	(5.6)	(-)	(1.1)	(5.3)	(-)	(19.2)
Pasture & Range	85.0	114.6	4.4	44.0	20.5	9.4	277.9
Forest	3.5	1.3	-	5.0	2.5	1.9	14.2
Other	0.7	-	-	0.2	-	12.7	13.6
TOTAL	96.8	121.5	4.4	50.3	28.3	24.0	325.3

Source: 1967 Conservation Needs Inventory

necessary to limit crop use to those species that are tolerant to wet conditions.

One specific area that is encountering this type of problem is the bottomland at the mouth of Ponca Creek adjacent to the Missouri River. In this area the increasing sediment deposition in the upper reaches of the Lewis and Clark Reservoir are raising the water table to where some areas can no longer be cropped.

D. Water Shortages

The basin is directly dependent upon precipitation for water supply from both surface and ground sources. When moisture deficiencies deviate greatly from average conditions, water-dependent functions suffer severely.

Agricultural crops and pastures are immediately affected during low growing-season rainfall. Unless supplemental water is provided, reduction in yield, and therefore income, results. Current investment costs in producing food and fiber are relatively insensitive to local moisture conditions but the farm and ranch community find it increasingly difficult to tolerate even moderate water shortages.

The development of irrigated areas have resulted in a steady lowering of the ground water levels in an area around Alliance and also an area in Holt County. Application of surface waters and ground water recharge are not adequate even in normal years to support the increasing

demand for irrigation water. North of Alliance records show a drop in water level of over 40 feet in one well and over 35 feet in another. This drop has occurred in the 24-year period of record 1946-1969. County-wide, this computes to approximately two million acre feet. The maximum extent of the drop in the Holt County area for the same period of record is about 20 feet.

Where surface water is a prime source of supply for livestock, drought periods produce critical situations which may force either development of ground water for supply, hauling or piping of water or relocation of the operation. Local areas in Keya Paha, Boyd, and Knox Counties have experienced a shortage of water for municipal, industrial, and rural domestic uses. Problems of location of adequate supply encouraged the organization of a rural water district in Boyd County.

Administration of water rights on the Niobrara River from the state line down to the Mirage Flats District diversion dam has occurred each year since the completion of the project, whether precipitation in this area is above or below normal. Appropriations with priorities junior to January 25, 1937 (date of appropriation for the diversion dam) in this section have been closed from two to as much as three and one-half months during the irrigation season. This affects ten separate grants for a total of some 19 cfs. Total appropriation in this reach amounts to 129 cfs. The diversion dam near Dunlap has claim to 196 cfs for the irrigation project and storage rights for 47,670 acre-feet.

In 1970 a severe shortage of water in the Keya Paha River occurred. Surface-supplied irrigation development has expanded greatly and there is neither sufficient quantity of ground water nor storage reservoirs to supply supplemental water.

Municipal, industrial, and rural domestic functions are not generally as severely affected as agriculture in periods of below normal precipitation as these functions depend almost entirely on ground water. Water shortages are limited to very short durations and then only to the extent of some rationing of water. The vast ground water reservoir in the central portion of the basin tends to dampen and delay the adverse affect of low recharge years in the basin downstream of the Sandhill region.

Periods of low rainfall and streamflow have a damaging effect on the basin's fish and wildlife habitat, population, and propagation. Water-based recreation activities also may become limited when there is a decline in the quantity of available surface water.

E. Range and Forest Problems

An average of about 60 range and grass fires occur each year in the basin, burning an average of about 10,000 acres. About 40 percent of the fires are started by lightning and 60 percent are man-caused by careless debris burning, smoking, and from equipment use including rail-

roads. Large fires are a continuing threat especially on the rangeland and forest plantations in the western portion of the basin.

The effects of damage from range fires are the loss of the current year's forage to the individual landowners and operators and the temporary removal of the protective cover. This loss of cover increases surface runoff which reduces available moisture for plant growth, increases soil erosion, and causes additional downstream flooding.

The problems and damages from forest fires are longer lasting. These fires destroy the ground cover of litter and humus; kill young trees and shrubs, and damage but rarely kill larger trees. Damages of greater impact, but not so easily measured, are the indirect effects to the hydrologic condition; the increase in surface runoff; the increase of soil erosion; the retardation in tree growth; the reduction in timber quality; and the reduction in resistance of trees to disease and insect infestation.

One of the greatest damages to basin woodlands has been caused by livestock grazing and using the woodlands for shade and shelter. Browsing soon kills seedlings, and young trees, and removes the understory vegetation. Heavy trampling and trailing of livestock compacts the soils and humus and seriously impairs the capacity of the woodlands to retard erosion and reduce peak runoff. Currently, about 105,000 acres of forest and woodland are grazed by livestock and subject to this type of damage.

Insect and disease cause losses in timber production through reduction in growth, lower quality, deformities, rot, and death of trees. The occurrence of the Dutch elm disease is killing most of the American elm. The dead trees cause increased damage to bridges during floods and add to the debris left on land by floods.

There has been little management of woodlands for the purpose of enhancing commercial production. Instead, woodlands have been "picked over", the best trees taken and the inferior trees left. Almost no planned replacement of trees has been performed and often the areas have been invaded by dense stands of seedlings of less desirable species.

F. Pollution

The problem of pollution in the Niobrara Basin primarily involves ground and surface waters. Air pollution problems are usually rare and when existent are generally local in extent, constituting nuisances rather than substantial hazards. Pollution of air or water is usually of concern only when pollutants are present in large enough concentrations to constitute a menace to human and animal health.

Historically, streams have been used to carry away waste water and pollutants that have been returned to, or have found their way into the streams. When large amounts of dilution water are available, pollution is not a serious problem. However, as additional wastes are added to streams, and as increased water use decreases surface flows,

the quality of the water in the streams deteriorates. This reduced quality can cause health hazards for humans and has been and will continue to be damaging to the fish and wildlife that are dependent on these stream flows for their survival.

According to the Interim Plan for Water Quality Management in the Niobrara Basin (October 1971, updated to September 1972) 15 towns have inadequate waste treatment facilities in various stages of urgency. Ten towns do not have secondary treatment and five towns have inadequate seconadary treatment.

The amount or seriousness of the pollution problem for any of these municipal communities is dependent on a number of factors and existing conditions need to be evaluated for each community to determine the nature of pollution problem. It is reasonable to assume that some smaller communities currently having no public treatment plant may be adequately treated with individual septic tank systems.

In addition to the municipal wastes from the incorporated communities potential pollution problems arise from industries that do not discharge their wastes into municipal treatment systems. Also potential pollution problems exist in unincorporated communities and the rural households due to either inadequate treatment or from sewage systems that discharge directly into water courses.

The major agriculture pollutant in the basin is sediment. Land treatment on much land is still lacking and as a result excessive soil movement continues. Sediment from erosion causes such harmful effects as the clogging of local stream channels, the destruction of fish habitat, and the reduction of recreational value of surface waters. Runoff from agricultural areas transports agricultural chemicals from the soil. These chemical residues include fertilizers and pesticides which can build up toxic concentrations to affect the biota of the receiving streams.

The feeding of livestock is increasing in parts of the Niobrara, but it is not carried on to the degree that is true of certain other basins in Nebraska. The feeding of cattle, which is the major feeding operation, has increased from about 58,000 in 1964 to 91,000 in 1970. A major portion of this increase has occurred in Box Butte, Brown, and Holt Counties. An estimate of the number of cattle on feed for each county, for the portion of the area located in the basin is shown in Table IV-6.

Methods of livestock production have changed in the last decade. Specialized, large scale production in feedlots and confined housing has introduced new pollution problems. This confinement has increased odor, dust, and insect problems in addition to water pollution potential. Concentration of large numbers of animals in small areas means that it is no longer economically feasible for livestock wastes to be dropped on pastures where they can be broken down without creating nuisance conditions.

TABLE IV-6.--CATTLE ON FEED
NIOBRARA RIVER BASIN, NEBRASKA

County	1964	1966	1968	1970
Antelope	5,700	7,000	9,700	10,200
Box Butte	6,700	7,600	7,400	17,400
Boyd	7,500	5,900	6,300	7,400
Brown	6,200	4,700	9,800	14,000
Cherry	500	1,400	2,200	2,600
Holt	7,100	8,900	15,100	14,600
Keya Paha	1,300	1,800	800	800
Knox	16,100	18,400	21,700	17,600
Sheridan	4,200	4,900	4,400	3,300
Sioux	1,900	1,700	2,000	2,000
Others	900	800	700	1,000
TOTAL	58,100	63,100	80,100	90,900

Source: Nebraska Agricultural Statistics, Nebraska Department of Agriculture and State-Federal Division of Agriculture Statistics.

In 1957 the Nebraska legislature passed the Water Pollution Control Act, the general purpose being to reduce and control the pollution of waters of the state. Under the Act a state Water Pollution Control Council was created. On March of 1968, the Council adopted a regulation requesting that feedlots in certain categories of size and location be voluntarily registered.

Voluntary registration did not receive adequate cooperation from feeders, and in June of 1972 the Environment Control Council changed the program from a voluntary to a regulatory type. Under this program the Department of Environmental Control (D.E.C.) will make on-site inspections of livestock operations throughout the state to determine if waste controls are required.

Known livestock operations which are believed to need waste controls are contacted by letter, and these will be visited by the D.E.C to determine if waste control facilities are required. When controls are required a compliance schedule will be set up for preparation of plans and completion of construction.

Any operator who has not been contacted by August 31, 1972 and feels that he may have a pollution control problem has a responsibility to contact D.E.C. requesting inspection. Operators need a decision from the D.E.C. stating that livestock waste controls are required in order to get design assistance from the Soil Conservation Service and cost-sharing funds from the Rural Environmental Assistance Program (REAP) through the Agricultural Stabilization and Conservation Service (ASCS).

All proposed and expanding feedlots which require waste control facilities will require permits.

Table IV-7 shows the number of livestock in confinement on officially registered lots in the Niobrara River Basin according to major stream course. The existing feedlot regulation, issued by the Nebraska Department of Environmental Control, is that feeders must retain on their own property the runoff which can be expected from a 10-year, 24 hour-storm.

Not enough research has been done to permit much general quantification of pollution from confined feeding of livestock. Many variable factors, such as location of feedlots relative to water courses, management practices of individual operators, slope and soil characteristics make quantification difficult.

Current studies indicate that the quantity of sediment produced by the confined feeding of livestock is largely a function of area of feedlots rather than the numbers of livestock. The runoff from a sloping feedlot one acre in size lacking runoff control will produce a quantity of sediment roughly equivalent to that from an acre of cropland which lacks conservation treatment. Carrying the analogy further, at a density of 100 steers per acre, the sediment production from that area of feedlot is roughly equivalent to that from an acre of untreated cropland. However, the runoff and sediment from feedlots has a greater pollutional effect than from cropland because of the higher coliform count and the higher bio-chemical oxygen demand (BOD).

Odors from the evaporation of liquid wastes and the anerobic decomposition of liquid and solid waste are disagreeable to residents living in proximity to feedlots. In addition, air-born ammonia from evaporation of liquid wastes contributes nitrogen to nearby bodies of water, thus, accelerating the eutrophication of these waters.

G. Impairment of Natural Beauty

The attractiveness and beauty of the Niobrara River Basin are often impaired by the forces of man and nature. An objectionable amount of wind and sheet erosion occurs that reduces productivity and scars the landscape. Sediment from misused or inadequately treated areas results in increased sedimentation of streams and rivers, and adds to the turbidity of the streams, ponds, and lakes. These conditions contribute to lowered aesthetic value by impairing the natural beauty of the area. Overbank flooding, caused by snowmelt and runoff-producing rainstorms, causes permanent damage to agricultural land and facilities, thus reducing the aesthetic value of these properties. Periods of drought diminish or destroy much of the beauty of the vegetative cover. Although significant progress has been made in the application of conservation treatment and management of the agricultural land in the basin, much remains to be done.

TABLE IV-7.--NUMBER OF LIVESTOCK IN CONFINEMENT ON OFFICIALLY REGISTERED LOTS, NIOBRARA RIVER BASIN, NEBRASKA

County	Major Stream	Number of Registered Lots	Number of Head (Capacity)					
			Feeder Cattle	Beef Cows	Dairy Cows	Sheep	Swine	Chickens
Box Butte	Snake Cr.	5	7,500	350				
	Berea Cr.	3	1,050					
	Box Butte Cr.	1	750					
Sioux	Niobrara R.	1	800					
Brown	Plum Cr.	2	450					
	Bone Cr.	9	12,880	400			200	
	Sandy Cr.	2	750					
	Long Pine Cr.	1	1,000					
Boyd	Ponca Cr.	1	300					
Holt	Niobrara R.	1	80					
	Beaver Cr.	1	50	10	10	20	100	3,000
	Sandy Cr.	1	50				250	
	Brush Cr.	2	15,500	500				
	Eagle Cr.	2	550	530			35	500
	Red Bird Cr.	2	700				300	
Knox	Verdigre Cr.	5	700	10			190	
	Soldier Cr.	1	500	125				
	Pishel Cr.	2	300				250	
	Niobrara R.	2	350				100	
	Others 1/	3	850	230			500	
Rock	Pine Cr.	1	750					
	TOTAL	48	45,860	2,155	10	20	1,925	3,500

Source: Feedlot Registration Files of the Nebraska Department of Environmental Control, 1971.

1/ Includes (1) those without legal description and (2) those without discernible drainage patterns.

Much of the natural woodland has been managed with the objective of maximizing the agricultural production from grazing, rather than to improve the production or use of the forest areas. Consequently, this has reduced or impaired the beauty that is associated with the forest environment. Currently, the scourge of the Dutch elm disease is killing, or has killed many native American elm trees. The bare and bleached limbs of the dead trees mar the landscape and impair the beauty of the forested portion of the area.

The disposal of hard waste, such as old car bodies, worn-out machinery, tin cans, and bottles, has resulted in some unsightly dump grounds in or near urban and rural communities, or along main highway and county roads. Many of these junkyards and auto graveyards are not adequately screened with trees, shrubs, fences, or are not adequately maintained. Many abandoned farmsteads and other manifestations of our past and modern society also impair the natural beauty of the basin.

V. PRESENT STATUS AND FUTURE NEEDS FOR WATER AND RELATED LAND RESOURCE DEVELOPMENTS

The application of measures that provide protection and management, including all types of conservation treatment and practices, is a basic need in the conservation, development and utilization of land and water resources. Protection and management measures are needed for crop, pasture, and forest lands throughout the basin. There is a need to treat land according to its needs, and to use it in accordance with its capabilities. Structural measures may be required to protect lands subject to flooding, dispose of excess water from agricultural lands, reduce erosion, and provide storage for water supplies, and enhance other beneficial uses. Application of nonstructural measures are needed to limit or reduce future flood damages.

A. Land Treatment and Management

Proper management, vegetative, and mechanical land treatment practices are needed to control erosion on agricultural land. Management practices include maintenance of soil fertility, proper management of plant residue, efficient use of irrigation water, and controlled grazing. Vegetative practices include range seeding and reseeding, tree planting, and establishment of grassed waterways. Mechanical practices include terracing, diversions, land leveling, and grade control structures. Some types of problems need only proper management practices. Other erosion problems necessitate in addition to proper management, the application of vegetative and/or mechanical practices.

Out of a total of 7,090,000 acres of agricultural land in the Niobrara Basin, 3,790,000 acres, or 53 percent, are adequately treated. Of the remaining 47 percent, 27 percent, or 1,897,000 acres, needs management, vegetative, and mechanical practices and 20 percent, or 1,403,000 acres, needs only management practices. Table V-1 gives a breakdown of the treatment status and soil loss on agricultural land in the basin by major land use.

Over 80 percent of the agricultural land in the basin, or 5,584,000 acres, is devoted to pasture and range. Fifty-nine percent of the pasture and range is adequately treated; only 19 percent needs vegetative and/or mechanical practices; and 22 percent needs only management practices.

Only 18 percent, or 1,337,000 acres, of the agricultural land in the basin is devoted to crop production, and only 145,000 acres of this is irrigated cropland. Of the 1,192,000 acres of nonirrigated cropland, 34 percent is adequately treated, 60 percent needs vegetative and/or mechanical practices, and six percent needs proper management. Of the

Table V-1.--CONSERVATION TREATMENT AND SOIL LOSS ON AGRICULTURAL LAND
NIOBRARA RIVER BASIN, NEBRASKA

Item	Total	Land Adequately Treated		Land Needing Treatment: Proper Management Practices Only		Land Needing Treatment: Proper Management & Vegetative and/or Mechanical Practices		Soil Loss	
	Acres (000)	Acres (000)	Percent	Acres (000)	Percent	Acres (000)	Percent	Tons/Yr (000)	Tons/Ac/Yr
Cropland									
Non-Irrigated	1,192	411	34	73	6	708	60	4,273	3.6
Irrigated	145	35	24	71	49	39	17	154	1.1
Total Cropland	(1,337)	(446)	(33)	(144)	(11)	(747)	(56)	(4,427)	(3.3)
Pasture & Range	5,584	3,295	59	1,228	22	1,061	19	4,373	0.8
Forest Land	119	22	18	20	17	77	65	23	0.2
Other Ag. Land	50	27	54	11	22	12	24	77	1.5
TOTAL	7,090	3,790	53	1,403	20	1,897	27	8,900	1.25

Source: USDA, Conservation Needs Inventory, 1967.

145,000 acres of irrigated cropland, 24 percent is adequately treated, 49 percent needs only proper management, and 27 percent needs vegetative and/or cultural practices.

Only 119,000 acres, or less than two percent, of the agricultural land in the basin is devoted to forest and woodlands. Of the 119,000 acres, only 22,000 acres, or 18 percent, is adequately treated; about 17 percent of the area needs only proper management; and about 65 percent of the area needs vegetative and mechanical practices in addition to proper management.

Soil losses, from water erosion, are quite low in the basin, averaging one and one-quarter (1.25) tons per acre basin wide. There is considerable range in soil loss rates per acre, varying by the kind of land use, soil type, and conservation treatment. Cropland, non-irrigated, is estimated to average 3.6 tons per acre, with irrigated cropland averaging a little over 1 ton per acre. Pasture and range losses are estimated to be just over 3/4 of a ton per acre annually, and forested land about 1/5 of a ton per acre annually. Total soil losses amount to over 8.5 million tons per year, with cropland losses amounting to about 1/2 of the total loss, or 4.3 million tons.

B. Flood Prevention and Sediment Control

The present and future needs for flood prevention and sediment control are based on the current average annual damages and their projection for the bench mark years of 1980, 2000, and 2020. In this report, damages have been computed for only the 76,500 acres of upstream floodplain area needing project action.

The current average annual floodwater and sediment damage for the upstream area is estimated to be $308,120. Under projected economic development, this damage is expected to increase to $436,300 by 1980, $604,000 by 2000, and $842,100 by 2020. A detailed damage evaluation for each of the watersheds in the basin is shown in Table V-2.

The programs needed to reduce and minimize flood damages include both structural and nonstructural measures. Full consideration should be given to land treatment measures before project-type structural measures are applied. Structural solutions to flood problems include floodwater retarding structures, channel improvements, and levees and dikes. An integrated approach considering flood, sediment, and related problems should be followed in determining the need for structural measures and supporting watershed management and protection practices.

Reservoir control of 40 to 60 percent of the total drainage area is usually needed for effective reduction of flood damages. Under project-type development, the minimum floodwater storage capacity that can be provided is for a 25-year frequency runoff event, without operation of the emergency spillway. Capacity is also provided for at least 50 years accumulation of sediment.

Table V-2.--SUMMARY OF CURRENT AND PROJECTED RESIDUAL FLOODWATER AND SEDIMENT DAMAGES
NIOBRARA RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Drainage Area	Area Needing Project Action	Average Annual Damage			
				Current Flood Damages	Under Projected Economic Development		
Number	Name				1980	2000	2020
		(Acres)	(Acres)	(Dollars)			
28 - 2	Van Tassell Creek	11,700	0	0	0	0	0
28 - 3	Niobrara-Harrison	100,100	1,250	1,100	1,600	2,200	3,000
28 - 4	Niobrara-Agate	167,700	2,550	2,100	3,000	4,100	5,700
28 - 5	Whistle Creek	95,400	600	600	900	1,200	1,600
28 - 6	Niobrara-Marsland	210,100	4,550	4,550	6,500	8,900	12,400
28 - 7	Sand Creek	75,400	750	2,300	3,300	4,500	6,300
28 - 8	Dunlap Tribs	125,800	4,100	5,850	8,300	11,500	16,000
28 - 9	Mirage Flats	114,900	3,350	27,500	39,100	53,900	75,100
28 -10	Box Butte Creek	158,700	1,850	3,800	5,400	7,400	10,400
28 -11	Snake Creek (Upper)	184,300	500	900	1,300	1,800	2,500
28 -12	Point of Rocks Creek	95,500	1,000	3,100	4,400	6,100	8,500
28 -13	Berea-Hemingford Creeks	117,200	1,500	7,000	9,900	13,700	19,100
28 -14	Snake Creek (Lower)	218,400	2,000	5,000	7,100	9,800	13,700
28 -15	Rush Creek	142,900	5,100	9,650	13,700	18,900	26,300
28 -16	Niobrara-Sheridan Tribs	75,700	400	1,000	1,400	2,000	2,700
28 -17	Antelope Creek 1/	107,000	2,300	2,700	3,900	5,300	7,400
28 -18	Niobrara Sandhills	2,648,200	7,200	14,500	20,600	28,400	39,600
28 -19	Minnechaduza Creek	162,300	1,150	3,350	4,800	6,600	9,100
28 -20	Niobrara Tribs (Cherry-Keya Paha)	118,600	1,000	4,000	5,700	7,800	10,900
28 -21	Plum Creek (Upper)	200,600	1,400	2,100	3,000	4,100	5,700
28 -22	Plum Creek (Lower)	90,400	600	1,100	1,600	2,200	3,000
28 -23	Bone Creek	126,800	600	3,100	4,400	6,100	8,500
28 -24	Long Pine Creek	166,300	450	2,100	3,000	4,100	5,700
28 -25	Riverview Tribs	106,700	200	2,400	3,400	4,700	6,600
28 -26	Mariaville Tribs	179,000	900	4,500	6,400	8,800	12,300
28 -27	Big Sandy Brush Creek	142,600	2,550	7,700	10,900	15,100	21,000
28 -28	Turkey Creek Tribs	77,700	150	1,400	2,000	2,700	3,800
28 -29	Eagle Creek	132,300	3,200	17,200	24,400	33,700	47,000
28 -30	Redbird Creek	104,100	2,650	12,900	18,300	25,300	35,200
28 -31	Verdigre Creek (Upper)	207,200	5,900	31,200	44,300	61,200	85,200
28 -32	North Branch Verdigre Cr.	93,400	1,050	5,000	7,100	9,800	13,700
28 -33	Verdigre Creek (Lower)	53,800	3,000	27,000	38,300	52,900	73,700
28 -34	Niobrara River (Lower)	137,400	2,200	10,700	15,200	21,000	29,200
28a- 2	Sandy Shady Creek	47,400	0	0	0	0	0
28a- 3	Lost-Holt	142,800	900	2,700	3,800	5,300	7,400
28a- 4	Burton-Spring	121,500	600	1,850	2,600	3,600	5,100
28a- 5	Keya Paha Tribs (Lower)	106,500	500	2,050	2,900	4,000	5,600
27 - 2	Ponca Creek	14,800	650	5,750	8,100	11,300	15,800
27 - 3	Ponca Creek (Middle)	110,000	6,900	60,300	84,400	118,200	165,200
27 - 4	Ponca Creek (Lower)	153,400	950	8,050	11,300	15,800	22,100
	TOTAL	7,444,600	76,500	308,120	436,300	604,000	842,100

1/ Watershed project completed.

Price Base: Long-term projected prices for completed watershed project. Adjusted normalized prices for the remainder of the watersheds.

Application of nonstructural measures will reduce future flood damage increases. Review of historical flood data indicates that total flood damages continue to increase, even though flood control programs have been implemented because more intensive use has been made of the floodplain. Nonstructural measures that could be used to reduce future flood damages include: land management, flood forecasting, flood fighting, floodway regulation, floodplain planning and zoning, and floodproofing of structures. Floodplain insurance covers flood hazards and although it cannot reduce flood damges, it can provide a means of speading the cost of flood losses. Legal and institutional arrangements will govern the applicability and implementation of nonstructural phases of flood control.

C. Gully and Streambank Stabilization

There is need for a wide variety of gully stabilization measures on the 777,750 acres of area having a gully erosion problem in the basin. Possible means of reducing the damages from gully erosion include the installation of conservation practices in the upland areas and the construction of grade stabilization structures in gully problem areas.

Approximately 768,750 acres of the total area needing gully stabilization have been classed as on-farm problems that can be controlled by land treatment measures. Only 9,000 acres have been considered as the area needing project action. The current average annual gully erosion damages have been estimated to be $235,000. This damage is projected to increase to $366,700 in 1980, $518,900 by 2000, and $747,900 by 2020. A detailed evaluation for each of the watersheds in the basin is shown in Table V-3.

About 18 percent of the streambanks are subject to erosion, but the rates of damage range from low to moderate. Most measures to alleviate bank erosion have been of an emergency or temporary nature and have been aimed at protecting the most critical areas. It can be assumed that emergency measures will continue to be used for temporary protection. The installation of more permanent measures, such as rock revetments, is desirable whenever local conditions justify their use. Increases in the economic losses due to future development, in combination with possible advances in the technology of bank stabilization, may provide an economic basis to justify protection of relatively long reaches.

D. Drainage Improvement

Not all of the 325,300 acres of agricultural land having an excess water problem are in need of drainage. Instead, present and future drainage needs are dependent on the desired use of the areas having drainage problems. The potential economic return for the landowner will usually determine the use.

Generally, soils in land capability classes IIw, IIIw, and IVw, are feasible to treat for agricultural production. Table IV-5 shows that there are presently 222,700 acres in these classes. Some areas are already adequately treated while other areas have only partial treatment. A large portion is presently being used as subirrigated hay meadows and pasture where there is very little need for drainage unless a change of land use is desired. If a more intensive use is planned for this area some type of drainage improvements will be needed.

The watershed projects section of the 1967 Conservation Needs Inventory (see Table IV-1) has estimated that 145,900 acres have a drainage problem and that 119,000 acres of this area will need some type of project development to alleviate the problem. The installation of open drains will often be needed to properly dispose of the excess water.

Table V-3.--SUMMARY OF CURRENT AND PROJECTED GULLY EROSION DAMAGES
NIOBRARA RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Drainage Area	Area Having Problem	Area Needing Project Action	Current Annual Damage			
					Current Gully Damages	Under Projected Economic Development		
Number	Name					1980	2000	2020
		(Acres)	(Acres)	(Acres)	(Dollars)			
28 - 2	Van Tassell Creek	11,700	0	0	0	0	0	0
28 - 3	Niobrara-Harrison	100,100	10,000	0	3,000	4,700	6,600	9,500
28 - 4	Niobrara-Agate	167,700	24,000	0	7,100	11,100	15,700	22,600
28 - 5	Whistle Creek	95,400	8,000	0	2,300	3,600	5,100	7,300
28 - 6	Niobrara-Marsland	210,100	42,000	0	12,500	19,500	27,600	39,800
28 - 7	Sand Creek	75,400	3,000	0	900	1,400	2,000	2,900
28 - 8	Dunlap Tribs	125,800	20,000	0	5,900	9,200	13,000	18,800
28 - 9	Mirage Flats	114,900	33,000	0	9,800	15,300	21,700	31,200
28 -10	Box Butte Creek	158,700	7,000	0	2,100	3,300	4,600	6,700
28 -11	Snake Creek (Upper)	184,300	1,000	0	300	500	700	1,000
28 -12	Point of Rocks Creek	95,500	5,000	0	1,500	2,300	3,300	4,800
28 -13	Berea-Hemingford Creeks	117,200	1,500	0	400	600	900	1,300
28 -14	Snake Creek (Lower)	218,400	2,000	0	700	1,100	1,500	2,200
28 -15	Rush Creek	142,900	12,500	0	3,700	5,800	8,200	11,800
28 -16	Niobrara-Sheridan Tribs	75,700	18,000	0	5,300	8,300	11,700	16,900
28 -17	Antelope Creek 1/	107,000	15,000	0	4,500	7,000	9,900	14,300
28 -18	Niobrara Sandhills	?,648,200	32,000	0	9,500	14,800	21,000	30,200
28 -19	Minnechaduza Creek	162,300	15,000	0	4,500	7,000	9,900	14,300
28 -20	Niobrara Tribs (Cherry-Keya Paha)	118,600	23,000	0	6,800	10,600	15,000	21,600
28 -21	Plum Creek (Upper)	200,600	2,250	0	600	1,000	1,300	1,900
28 -22	Plum Creek (Lower)	90,400	15,000	0	4,500	7,000	9,900	14,300
28 -23	Bone Creek	126,800	30,000	0	8,900	13,900	19,700	28,300
28 -24	Long Pine Creek	166,300	17,000	0	5,000	7,800	11,000	15,900
28 -25	Riverview Tribs	106,700	15,000	0	4,500	7,000	9,900	14,300
28 -26	Mariaville Tribs	179,000	13,500	0	4,000	6,200	8,800	12,700
28 -27	Big Sandy Brush Creek	142,600	50,000	0	14,800	23,100	32,700	47,100
28 -28	Turkey Creek Tribs	77,700	6,800	0	2,100	3,300	4,600	6,700
28 -29	Eagle Creek	132,300	50,000	0	14,800	23,100	32,700	47,100
28 -30	Redbird Creek	104,100	50,000	0	14,800	23,100	32,700	47,100
28 -31	Verdigre Creek (Upper)	207,200	75,000	0	22,300	34,800	49,300	70,900
28 -32	North Branch Verdigre Cr.	93,400	21,400	0	6,300	9,800	13,900	20,000
28 -33	Verdigre Creek (Lower)	53,800	16,000	0	4,800	7,500	10,600	15,300
28 -34	Niobrara River (Lower)	137,400	71,200	0	21,100	32,900	46,600	67,100
28a- 2	Sandy Shady Creek	47,400	0	0	0	0	0	0
28a- 3	Lost-Holt	142,800	1,000	0	300	500	700	1,000
28a- 4	Burton-Spring	121,500	15,000	0	4,500	7,000	9,900	14,300
28a- 5	Keya Paha Tribs (Lower)	106,500	6,000	0	1,800	2,800	4,000	5,700
27 - 2	Ponca Creek	14,800	1,000	0	300	500	700	1,000
27 - 3	Ponca Creek (Middle)	110,000	16,000	4,500	7,300	11,400	16,100	23,300
27 - 4	Ponca Creek (Lower)	153,400	33,600	4,500	11,500	17,900	25,400	36,700
	TOTAL	7,444,600	777,750	9,000	235,000	366,700	518,900	747,900

Price Base: Long term projected prices for the completed watershed project. Adjusted normalized prices for the remainder of the watersheds.

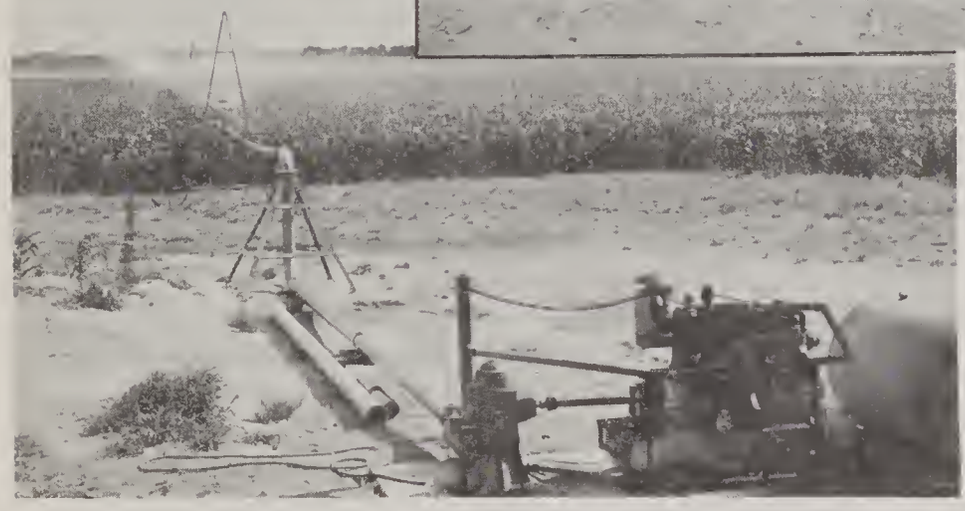
1/ Completed watershed project.

Land leveling, diversions and other on-farm drainage practices will also often be needed to adequately treat the problem areas.

E. Irrigation

Drought is one of the greatest deterrents to a sustained high level of agricultural production and as a result, there is need for irrigation development to stabilize production for the individual landowner. The economy in the Niobrara River Basin is basically agricultural and therefore irrigation and the related developments are need to help provide economic stability for individual farm operators.

Gravity Irrigation



Sprinkler Irrigation

In this study, the area currently being irrigated was estimated to be 145,000 acres. This includes both private and project development that uses both surface and ground water as its source of supply. The use of supplemental irrigation water is well established in this area, and future irrigation development is dependent on the availability of suitable land having an adequate water supply. It has been estimated that over two million acres of land in the basin have been classed as suitable for irrigation. Part of this area can be supplied by additional ground water development. Other areas will need to be developed with surface water supplies with still other areas having no ground or surface water supplies. A large portion of the land classed as suitable for irrigation is located in the Sandhills region. Ground water is available in this area with the need for irrigation dependent on the type of farming or ranching enterprise desired within this area.

It is anticipated that future irrigation requirements will be satisfied by both private and public project-type development. The projections of future needs in this report pertain only to private irrigation

development. It is estimated that an additional 160,000 acres of private irrigation will be developed by 2020. The planning of public irrigation projects is not the responsibility of the USDA, however, the Bureau of Reclamation has identified some 151,000 acres of land suitable for public project type irrigation. The Mirage Flats Project, about 11,660 acres, is operational and the O'Neill Unit, about 77,000 acres, is being considered by Congress for construction authorization.

Improved irrigation water management is needed on both existing and future irrigation development to realize the projected total output for the basin. Land forming, using irrigation guidelines, relative to such items as gradient, length of run, and re-use pits, is needed to promote optimum efficiency in water use and reduce damages both within the systems and to downstream areas.

F. Livestock Water Supply

The present and future needs for livestock water are dependent on existing and projected livestock numbers and on the source of water used to satisfy need. The present consumption requirements were estimated using the livestock numbers on hand January 1, 1966. Consumption rates used were 30 gallons per day (gpd) for milk cows, 12 gpd for beef cattle and calves, 4 gpd for hogs, 1.8 gpd for sheep, and 0.06 gpd for chickens. The current requirement for the basin was estimated to be 7.9 million gallons per day (24.3 acre feet) with the annual consumption requirement being 8,900 acre feet.

Ground water is the most important source of livestock water in the basin. About 75 percent of the current consumptive requirements are satisfied by this source. Ground water supplies are usually more uniform in quality and more dependable than water from surface supplies. These factors along with the widespread availability of ground water has been conducive to a stable livestock industry in the basin.

However, even in areas with adequate ground water supplies, some of the livestock water requirements are met from surface sources. Ground water developments require wells and pumps with some source of power, such as windmills. These installations are subject to the absence of winds, occasional breakdowns, and operational costs. To overcome these deficiencies, as well as to secure better distribution of grazing, stockmen need to construct livestock ponds or rely on existing lakes and streams to furnish the remaining 25 percent of the livestock water needs.

Since many of the existing livestock ponds have relatively small storage capacities, their effectiveness is dependent on surface runoff to replace the annual consumptive use and an amount lost to evaporation. Since the evaporation losses are a sizeable amount in comparison to consumptive use, they need to be included to obtain the total livestock water requirement. In order to determine evaporation loss, a study of pond numbers and surface areas was made in estimating the current annual evaporation loss of 6,000 acre feet.

Future livestock water requirements were made by projecting livestock numbers at the target periods of 1980, 2000, and 2020. It is expected that livestock production will double by 2000 and nearly triple by 2020. This will increase the consumptive use from the existing 8,900 acre feet to 24,500 acre feet by 2020.

Ground water will continue to be the principal source of livestock water and will furnish most of the additional requirements. The existing ratio of 75 percent ground water to 25 percent surface water was used in projecting the future requirements for each source.

In estimating the future evaporation losses, it was assumed that the number of livestock ponds will remain about the same. However, there is expected to be a shift toward the installation of larger ponds in larger drainage areas. These new ponds will provide a more dependable supply for both the existing and projected livestock surface water requirements. Due to the greater total surface area of these new livestock ponds, the projected evaporation losses will increase from the existing 6,000 acre feet to 9,000 acre feet by 2020.

The total livestock water requirements, including both consumption and livestock pond evaporation, will increase from the current 14,900 acre feet to 33,500 acre feet by 2020. A detailed analysis for all time periods is shown in Table V-4.

Table V-4.--LIVESTOCK WATER REQUIREMENTS[1/]
NIOBRARA RIVER BASIN, NEBRASKA

Item	Current[2/]	1980	2000	2020
Water Consumption				
Annual Use - Ac.Ft.	8,900	12,900	17,200	24,500
Ground Water - Ac.Ft.	(6,700)	(9,700)	(12,900)	(18,400)
Surface Water - Ac.Ft.	(2,200)	(3,200)	(4,300)	(6,100)
Evaporation				
Livestock Ponds - No.	2,200	-	-	-
Surface Area - Acres	3,000	3,500	4,000	4,500
Annual Use - Ac.Ft.	6,000	7,000	8,000	9,000
Total Water Requirement				
Annual Use - Ac.Ft.	14,900	19,900	25,200	33,500

1/ Basic data from Nebraska State Water Plan.
2/ January 1, 1966.

G. Municipal, Industrial, and Rural Domestic Water Supply

The present and future requirements for municipal and rural domestic water use were estimated for the 1960 population and for the projected populations for 1980, 2000, and 2020. Industrial use, other than that supplied by municipal water systems, was obtained from data in the Nebraska State Water Plan.

To estimate the 1960 and future water supply requirements, use rates were established for urban, rural non-farm, and rural farm populations as defined in Chapter III. A use rate of 170 gallons per capita day (gpcd) was assumed for the 1960 urban population and was increased to 200 gpcd by 2020. In the rural non-farm population group, the 1960 use was estimated to be 100 gpcd and increased to 120 gpcd by 2020. The 1960 domestic use rate in the rural farm group was assumed at 50 gpcd and projected to be 80 gpcd by 2020.

The annual 1960 water supply requirement for the urban area was estimated to be 2,040 acre feet. The projected increase in population and the projected increase water use rate will increase this requirement to 2,760 acre feet by 2020. The 1960 requirement for the rural non-farm population grouping was estimated to be 1,770 acre feet, with the 2020 requirement 2,270 acre feet. In this basin the increased use rate has less effect than the projected decreasing population. There also is a decrease in the rural farm requirements from 1,150 acre feet in 1960 to 820 acre feet in 2020. In combining the three population groupings that make up the total municipal and rural domestic water supply requirements, we find that the needs increase from 4,960 acre feet in 1960 to 5,850 acre feet in 2020. Table V-5 shows these requirements for all projection periods for each population grouping.

Industrial water requirements not supplied by municipal systems were estimated to be 60 acre feet in 1960 and are projected to increase to 200 acre feet by 2020. This requirement added to the municipal and rural domestic requirements gives a combined 1960 estimated use of 5,020 acre feet. The total requirement will decrease to 4,790 acre feet in 1980, and then increase to 5,170 acre feet in 2000, and 6,050 acre feet in 2020. The projected total requirement in 2020 exceeds that in 1960 by only 1,030 acre feet because of a projected decline in population of over 7,900 people.

Ground water has been the principal source for municipal and rural domestic use and it appears that nearly all of the future needs will be supplied from this source of supply. The municipal water resources of 32 incorporated cities and villages were studied by consulting firms employed by the Farmers Home Administration of the United States Department of Agriculture. These studies indicate that five presently have an adequate water system; 17 communities need to improve their existing system, and the 10 remaining villages cannot justify public water systems. Details of the existing municipal water supply system needs are shown in Table V-6.

Table V-5.--ESTIMATED 1960 AND PROJECTED MUNICIPAL, INDUSTRIAL, AND RURAL DOMESTIC WATER SUPPLY REQUIREMENTS
NIOBRARA RIVER BASIN, NEBRASKA

Item	1960	1980	2000	2020
Urban				
Population	10,720	9,700	10,400	12,300
Rate/Capita (gpcd)	170	185	195	200
Ac. Ft./Yr.	2,040	2,010	2,270	2,760
Rural Non-Farm				
Population	15,012	14,900	15,000	16,900
Rate/Capita (gpcd)	105	110	115	120
Ac. Ft./Yr.	1,770	1,840	1,930	2,270
Rural Farm				
Population	20,627	12,600	10,400	9,200
Rate/Capita (gpcd)	50	60	70	80
Ac. Ft./Yr.	1,150	850	820	820
Sub-Total				
Population	46,359	37,200	35,800	38,400
Ac. Ft./Yr.	4,960	4,700	5,020	5,850
Industrial				
Ac. Ft./Yr.	60	90	150	200
Total				
Ac. Ft./Yr.	5,020	4,790	5,170	6,050

Table V-6.--MUNICIPAL WATER SUPPLY SYSTEM NEEDS, 1970
NIOBRARA RIVER BASIN, NEBRASKA

Category	System Adequate		Improve System		No System Needed		Total	
	Places	Pop.1/	Places	Pop.1/	Places	Pop.1/	Places	Pop.1/
Incorporated Communities								
Over 2,500	1	6,862	1	2,662			2	9,524
1,000-2,500			3	5,316			3	5,316
500-1,000	1	606	4	2,561			5	3,167
250-500	1	467	4	1,375			5	1,842
Under 250	2	276	5	729	10	425	17	1,430
TOTAL	5	8,211	17	12,643	10	425	32	21,279

1/ 1970 census data.

The general categories of improvement needed are (1) to increase capacity, (2) to increase storage capacity, (3) to add treatment facilities, and (4) to improve the distribution system.

The capacity for water can be improved by the addition of wells, or by obtaining water from other sources such as Rural Water Districts. Towns needing increased capacity include Bristow, Butte, Kilgore, Lynch, Springview, Verdel, and Verdigre.

Added storage is needed to meet peak demands and to increase supply for fire protection. Storage can be added by elevated tanks, and by surface reservoirs. Towns needing increased storage include Ainsworth, Gordon, Harrison, Verdel, and Verdigre.

Various types of treatment are needed, including treatment to reduce nitrates, iron, manganese, and coliform. Towns needing treatment facilities include Cody, Long Pine, Merriman, Valentine, and Verdel.

Improvements in the water distribution system include addition of water mains, the looping of dead ends, shortening of loops, addition of service outlets, and the proper directing of service to the industrial and residential districts where development is taking place, or has occurred. Towns needing increased service facilities include Ainsworth, Gordon, Hay Springs, Hemingford, Kilgore, Lynch, Long Pine, Merriman, and Rushville.

No detailed evaluation has been made of the facility needs of the people living in unincorporated communities and in rural farm and nonfarm households. A major portion of these households have individual pressure systems supplying adequate quantity and quality of water. However, there are areas in Keya Paha, Boyd, and Knox Counties where individual water systems are not adequate to meet existing needs. In these deficit areas, rural water supply districts (RWD) are needed to meet the future projected requirements. These RWD's can be supplied by wells which can tap onto adequate ground water supplies.

H. Recreation, Fish and Wildlife

As the country has changed from an agrarian society to the technological society of today, outdoor recreation has changed from a means of livelihood to a means of relaxation. No longer is it necessary to be a good shot in order to have meat on the table and the canoe is no longer a necessary mode of transportation.

As leisure time increases, outdoor recreation opportunities enable people to more fully enjoy life. In the past, quality recreation opportunities have been associated with water and this is expected to increase in the future.

The demand for recreation is the result of many interacting factors including population, socio-economic levels, urban or rural residence, age distribution, population density, and the location of desired faci-

lities. To fully evaluate current and projected demands two components must be considered. These components are the expressed demand (the actual use of the resource) and the latent or unfulfilled demand (the use over and above expressed demand that would occur if the recreational opportunity were optimum). Latent demand is difficult to quantify, but the potential exists to at least partially satisfy it in the future and it must be considered in calculating future demand.

Data from the comprehensive plan for "Outdoor Recreation in Nebraska" was used to determine present and projected demand for recreation. In this plan, compiled by the Nebraska Game and Parks Commission, the state was divided into 14 Socio-Economic Areas (SEA) to facilitate regional studies. Current and projected recreational demand was determined for each of these areas with the state demand being the total of the 14 Socio-Economic Areas.

The Niobrara River Basin is located in the Norfolk, Valentine, and Scottsbluff SEA's. Data from these three SEA's was prorated according to ration of 1970 population in the SEA to the 1970 population of the Niobrara River Basin area located in each SEA. For this study 22 percent of the Norfolk SEA, 50 percent of the Valentine SEA, and 15 percent of the Scottsbluff SEA was used to determine the peak season current and projected recreational demand for the Niobrara River Basin. These peak season demands were then converted to annual demands using factors developed from state peak season and annual demand totals for each of the 19 outdoor recreation activities inventoried in the Nebraska Game and Parks Commission comprehensive plan.

The total estimated annual demand for outdoor recreation in the Niobrara River Basin was estimated to be about 2,963,000 activity-days in 1967. This demand is projected to increase to 6,207,000 activity-days by 2020. Table V-7 lists the activities considered and the projections for 1980, 2000, and 2020.

The activity-day projections were converted to visitor-days using the assumption that on the average 2.5 activities occur for each daily visit to a recreational area. The total demand, using this unit of measure, is estimated to be 1,185,100 visitor-days in 1967. This demand is projected to increase to 1,557,300 visitor-days in 1980, 1,968,500 visitor-days in 2000, and 2,482,700 visitor-days in 2020.

Projected demand for activity days was converted into a demand for developed land and water areas. The demand for land amounted to 5,000 acres by 1980 and 6,000 acres by 2000. The demand for water areas increased from 2,700 acres in 1967 to 3,200 acres in 1980, and 5,200 acres in 2000.

Currently, there is a developed supply of 14,700 acres of land and 6,900 acres of water area in the basin. Urban areas account for 1,700 acres of the land and non-urban public areas account for the remainder of the land and water area.

TABLE V-7.--ANNUAL DEMAND FOR 19 OUTDOOR RECREATIONAL ACTIVITIES
NIOBRARA RIVER BASIN, NEBRASKA

Activity	1967	1980	2000	2020
	(Activity-Days)			
Picnicking	140,600			
Camping	19,400			
Hiking	17,100			
Nature Walks	71,600			
Walking for Pleasure	359,100			
Subtotal	607,800	734,000	931,900	1,220,500
Swimming	201,200			
Boating	74,600			
Water-Skiing	13,100			
Subtotal	288,900	413,900	589,000	851,600
Ice Skating	32,300			
Sledding	12,100			
Subtotal	44,400	68,500	104,400	154,700
Driving for Pleasure	786,100			
Playing Outdoor Games & Sports	201,200			
Bicycling	230,600			
Sightseeing	232,500			
Attending Outdoor Sporting Events	155,400			
Horseback Riding	66,500			
Outdoor Concerts	15,100			
Subtotal	1,687,400	2,338,600	2,922,700	3,578,600
Fishing	190,000	194,300	206,600	208,000
Hunting	144,300	143,900	166,700	193,400
GRAND TOTAL	2,962,800	3,893,200	4,921,300	6,206,800
(Visitor Days)	(1,185,120)	(1,557,280)	(1,968,520)	(2,482,720)

Source: Outdoor Recreation for Nebraska, 1968
Nebraska Game and Parks Commission

Nebraska Game & Parks Commission

White-Water Canoeing on the Picturesque Niobrara

Table V-8 shows a breakdown of the current supply and projected demand for land and water area for outdoor recreation activities.

In addition to the supply from public areas there is an undetermined amount of private recreation development and access to private water areas. The 1969 Census of Agriculture shows that over 20 farms or ranches in the basin provide some recreation services. Many other farms provide incidental recreation facilities with nearly all of the wildlife habitat and hunting provided on private lands.

A review of the 19 outdoor recreation activities inventoried in the Nebraska Game and Parks Commission Comprehensive Plan indicates that for some of these activities the existing facilities could supply the projected demands. However, since most recreational demands must be supplied within one to two hours driving time from those expected to participate, additional facilities and access are needed to satisfy the optimum demand in a sparsely populated area like the Niobrara River Basin. These additional developments, including improved access to existing facilities will satisfy both resident and non-resident demands.

Some basin rivers and streamsides may have reaches with unique or noteworthy characteristics which may qualify them for inclusion in the National Wild, Scenic and Recreation Rivers System. Investigations are needed to determine whether designated river reaches need to be preserved in their free flowing natural condition. A State of Nebraska System of Scenic and Recreation Rivers is needed to preserve the existing free flowing and riparian condition on some significantly scenic or recreation rivers that do not qualify for designation in the national system.

Table V-8.--SUPPLY AND DEMAND FOR RECREATION LAND AND WATER AREAS, NIOBRARA RIVER BASIN, NEBRASKA

Item	Current Supply	Current & Projected Demand 1967	1980	2000	2020
	(Acres)				
Urban Public Recreation Land	1,700	300	300	300	300
Non-Urban Public Recreation Land1/					
State Areas	(12,800)				
National Wildlife Refuges	(100)				
National Forest	(100)				
	13,000	3,700	4,700	5,800	7,300
Public Water Areas1/	6,900	2,700	3,200	5,200	6,600
Other Public Lands2/					
National Wildlife Refuges	(69,900)				
National Monuments	(3,200)				
National Forest	(115,100)				
	188,200	188,200	188,200	188,200	188,200
Other Public Waters2/					
National Wildlife Refuge	(7,700)				
	7,700	7,700	7,700	7,700	7,700

1/ Developed area and buffer zone for recreation activities other than hunting

2/ Areas available for non-developed recreation activities, hunting, fishing, and wildlife habitat. Demand is for maintenance of same at current level.

I. Water Quality Control

The use of surface water, especially in the future, will be dependent upon its quality. In order to maintain good quality streamflows, degrading pollutants will need to be controlled. Currently, the major sources of surface water pollution in this basin are municipal, industrial, and agricultural wastes. Much progress has been made in reducing the amounts of pollutants entering the streams. However, additional measures are apt to be needed to obtain the desired water quality control in the future.

Because this basin is agriculturally oriented, the control of agricultural wastes is of extreme importance. The greatest need is to reduce runoff and erosion and the resultant sediment entering streams,

lakes, and reservoirs. This can be accomplished by increased use of land treatment practices such as terracing and grassed waterways on cropland, and proper grazing on grasslands. Also, practices to reduce runoff and safely dispose of wastes from feedlots are needed to reduce the discharge of sediment and organic wastes into streams.

There is a need for more research to determine the quantities of nitrates and phosphates that may enter streams as a result of fertilization, especially on irrigated crops. Proper management of chemical fertilizers, especially in irrigated areas, is needed to reduce the possibility of leaching of nitrates into shallow ground water (which might eventually enter streams). A reduction of sediment entering streams is needed to reduce the amount of phosphorous which can enter surface waters.

Continued research is needed to determine economically feasible practices which will permit proper disposal of wastes from confined feeding operations. Specific practices currently under study include holding ponds and lagoons. These can be installed in many cases using research results to date. Proper location and design of new feedlots is needed to control runoff and organic wastes. In some instances it may be more feasible to relocate established feedlots.

The following eight towns in the basin have recently completed, or are constructing, completely modern waste disposal plants: Ainsworth, Cody, Gordon, Hay Springs, Long Pine, Rushville, Valentine and Verdigre, Anoka, Bristow, Crookston, Jamison, Kilgore, Merriman, Royal, Verdel, and Woodlake need to install secondary treatment facilities within 10-15 years. Within the next five years Hemingford needs to install secondary treatment facilities. Four towns which need to improve their secondary treatment plants within 10-15 years are Butte, Harrison, Spencer, and Springview.1/

Studies conducted by the Farmers Home Administration show that although municipal sewage treatment facilities have been provided in 17 of the 32 incorporated communities, only seven of these systems provide an adequate level of sewage treatment. The remaining ten communities need to improve their facilities by extending their collection system; providing additional capacity to their existing treatment plant; or providing secondary treatment.

Of the 15 incorporated communities without sewage treatment facilities, six need a central treatment system. In the remaining nine communities, individual waste treatment facilities adequately meet current needs. Municipal sewage treatment needs are shown in Table V-9 for all 32 of the incorporated communities in the basin.

In addition to the municipal sewage treatment needs, there is need for additional waste treatment facilities in some of the larger unincorporated communities and where rural farmsteads and households are concen-

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1/ Interim Plan for Water Quality Management in the Niobrara (1971) Study of Municipal Waste Treatment Needs updated to September 1972.

Table V-9.--MUNICIPAL SEWAGE TREATMENT NEEDS
NIOBRARA RIVER BASIN, NEBRASKA

Category	System Adequate		Improve System		New System		No System Needed	
	Places	Pop.1/	Places	Pop.1/	Places	Pop.1/	Places	Pop.1/
Incorporated Communities								
Over 2,500	1	6,862	1	2,662				
1,000-2,500	1	2,073	2	3,243				
500-1,000	1	570	4	2,597				
250-500	3	1,205	2	637				
Under 250	1	246	1	127	6	645	9	412
Total	7	10,956	10	9,266	6	645	9	412

1/ 1970 census data

trated in localized areas. No inventory was made of these needs. Generally, individual waste treatment systems will take care of the individual households.

Most industrial developments in the basin use municipal waste treatment facilities to treat their waste discharges. As a result there are only limited amounts of existing individual industrial needs. Although no inventory was made of these needs, industries such as sand and gravel suppliers and processors of agricultural products must provide control measures to keep their wastes from entering the streams. Temporary erosion control measures are also needed in areas under construction, such as highways, county roads, and building sites during the period when there is little or no vegetative cover.

VI. EXISTING WATER AND RELATED LAND RESOURCE PROJECTS AND PROGRAMS

A variety of programs provide technical services and assistance to develop water and related land resources. These programs are administered by various state and federal agencies. Although the programs administered by these agencies are comprehensive, the present level of funding for several of these programs is below present needs. Discussion of the significant resource programs follows:

A. United States Department of Agriculture Programs

1. Soil Conservation Service

The Soil Conservation Service (SCS) is a technical agency of the U.S. Department of Agriculture having the primary responsibility to assist farmers with soil and water conservation. SCS brings together the various disciplines needed to solve land and water conservation problems and gives on-site technical assistance to individuals in preparation of conservation plans for their land. In conservation planning, soil and land-capability maps or range-site and range-condition maps based on a detailed soil survey of the farm, ranch, or other land unit are prepared. After consideration of suitable alternatives for using and treating the land within its needs and capability, a conservation plan is prepared with the individual owner or operator deciding what to do on his land. The plan outlines needed action to conserve, develop and properly utilize soil, water, plant, and wildlife resources, including a timetable for doing these thins.

The SCS provides technical assistance for the more difficult practices called for in the conservation plan, such as layouts, design and supervision of construction of farm ponds, terrace systems, diversions, and waterways. Guidance is provided for maintaining the measures and practices after they have been applied.

Nearly 4,000 landowners or operators of over 5,000,000 acres of land in the basin are cooperators with the three natural resource districts. About 2,600 conservation plans have been prepared to date, covering some 4,000,000 acres.

About 4,000,000 acres of land have adequate land treatment measures applied. Cumulative land treatment in the basin includes (1) nearly 2,300 miles of terraces, (2) about 3,100 acres of grassed waterways and outlets for terrace systems, (3) nearly 900 grade stabilization structures, (4) some 88,000 acres of range seeding, (5) over 165,000 acres of pasture and hayland planting, (6) the conversion of 110,000 acres of cropland to grassland, and (7) the conversion of over 3,500 acres of cropland to woodland.

SCS provides soil maps and interpretations to local officials and planning boards, to developers and engineers, and to others engaged in state, regional, and community planning. Use of this information results in savings of time and money and in more accurate estimates of construction costs. It also results in land uses compatible with soil conditions, landscape, and flood hazard and in improved design of highways, parks, and housing developments. Detailed soil surveys have been completed on approximately 600,000 acres in the basin.

Small Watershed Program - Public Law 83-566

The SCS has the leadership for USDA activities under the Watershed Protection and Flood Prevention Act. The SCS works with local organizations that sponsor watershed projects and with individual land users in the project areas. Assistance includes helping in the preparation of a watershed work plan, the design and supervision of construction of the proposed measures and funds for construction of structural measures. This may include measures for watershed protection, flood prevention, irrigation, drainage, water supply, public recreation, and fish and wildlife developments. Antelope Creek Watershed Project in Sheridan and Cherry Counties is a 107,000 acre project completed in 1958 under the above Act.

Great Plains Conservation Program - Public Law 84-1021

The Great Plains Conservation Program, administered through the Soil Conservation Service, provides landowners the opportunity to plan needed conservation over a long period of time and to schedule installation of permanent land treatment practices on their entire operating unit. The federal government provides cost-sharing assistance in the application of approved practices. All counties in the basin have the Great Plains Program in operation. Over 500 long-term Great Plains contracts have been signed covering some 1,500,000 acres.

Resource Conservation and Development Program

The SCS is authorized to provide technical and financial assistance to local groups in conserving and developing their natural resources. These rural-urban projects are locally initiated, sponsored and directed, and provide local groups the opportunity to coordinate and use federal, state, and local facilities to develop the natural resources for economic improvement and community betterment.

Locally developed goals may include, but are not limited, to the following:

1. Develop land and water resources for agriculture, municipal or industrial use.
2. Provide soil and water information to other planning agencies for agricultural and nonagricultural uses.
3. Carry out conservation measures for watershed protection and flood prevention.
4. Accelerate soil surveys.
5. Reduce pollution of air, water, and soil.
6. Speed up conservation work on individual farms, ranches, and other private holdings.
7. Make needed adjustments in land use.
8. Improve or expand recreational facilities; promote historical and scenic attractions.
9. Encourage existing industries to expand and new ones to locate in areas in order to create jobs.
10. Improve markets for farm crops, forest products and livestock.
11. Improve, build, or bring to the area needed community facilities such as hospitals, schools, sewage treatment plants, and roads.
12. Train or retrain residents to improve job skills.

2. Forest Service

Cooperative state and private forestry programs are varied and cover virtually all major fields of forest management and protection. Cooperative programs include fire protection; technical assistance services; forest pest, insect, and disease control; tree seeding and planting; tree seedling production; forest management; forest watershed management; forest products harvesting, processing and marketing; and forest research.

The major cooperative programs are:

(1) Section 4 of the Clark-McNary Act of 1924 gives the U.S. Forest Service authority to cooperate with the states in growing and distributing tree seeds and planting stock to landowners.
(2) The Agricultural Act of 1956, Title IV, charges the Forest Service to assist the states in bringing into production commercial forest land not adequately stocked with marketable tree species.
(3) The Cooperative Forest Management Act of 1950, amended 1962, provides for programs designed to give assistance to private forest owners, especially owners of small woodlands. It also provides for assistance to loggers and processors of primary forest products.
(4) Section 2 of the Clark-McNary Act of 1924 provides authority for cooperative fire control. Under this act, the states and federal government have joined to provide for, or make avail-

able adequate fire control on nonfederal lands. The federal government can match state and private expenditures up to 50 percent.

These cooperative programs are well established and represent continuing progress in the basin. For example, during 1971 the Forest Service (1) distributed 200,000 trees for planting on small woodland areas; (2) furnished 150 landowners with forest management assistance involving 2,000 acres; (3) provided technical assistance in harvesting and marketing forest products to 125 landowners; and (4) assisted in organizing and equipping 20 fire control districts.

The Forest Service cooperates in the Rural Environmental Assistance Program with the Agricultural Stabilization Conservation Service, and gives technical assistance in forestry measures to private landowners, following the usual policy of working through the State Foresters. Technical assistance is provided for the acceleration of forestry practices in Public Law 83-566 small watershed projects and other applicable programs. The Forest Service does research in tree improvement by means of genetics in tree selection and breeding; tree windbreak management; studies of tree diseases; and works cooperatively in tree planting and shelterbelt research with the State Experiment Stations.

3. Extension Service

The Extension Service is part of the Cooperative Extension Service partnership. Federal, state, and county levels of government share in financing, planning, and carrying out information and educational programs. The Extension Service acts as the educational agency of the U.S. Department of Agriculture and the land grant universities. Extension specialists and county agents work with other agencies to provide local people with information relating to soil and water conservation programs plus other types of information and assistance. This work has been an integral part of USDA since 1914, when the Smith-Lever Act became law.

4. Agricultural Stabilization & Conservation Service

The Agricultural Stabilization and Conservation Service, through their Rural Environmental Assistance Program, provides cost-sharing to landowners and operators for carrying out conservation practices on agricultural land. This includes practices contributing to conservation and development of soil, water, plant, wildlife, and other resources as well those effective in reducing or controlling erosion, resulting sedimentation, and chemical, and animal waste pollutants. The cost-sharing program is available to individual farmers and ranchers as well as to groups of landowners who have common problems too large or complex to be handled individually. The program also provides cost-sharing for installing emergency conservation practices needed as a result of a

natural disaster. The Soil Conservation Service is responsible for the technical phases of the program.

The Agricultural Stabilization and Conservation Service administers the USDA Agriculture Farm Program, relating to agriculture production control. It also administers the Agriculture Commodity Storage and Loan Program.

During the period of 1966 through 1970, over 3,500 farms in the basin participated in the agricultural conservation program at least one time. Over 900 farms participated in calendar year 1970. Other assistance provided during 1970 included the following:

13,000 acres in cropland adjustment program
13,000 acres of establishment of permanent cover
70 agricultural water reservoirs constructed
100 storage bins constructed
$386,000 cost-shares paid

5. Farmers Home Administration

The Farmers Home Administration makes water development and soil conservation loans to eligible individual farmers, rural residents, and to groups of farmers and rural communities. These loans are for the purposes of developing water supply systems for domestic, livestock, and irrigation use, and for carrying out soil conservation practices. Each loan is scheduled for repayment in accordance with the borrowers ability to repay, over a period not exceeding 40 years. In addition to loans to individuals and groups, loans are also made to local organizations to help finance projects and develop land and water resources in watersheds planned under authority of Public Law 83-566. Eligible local organizations include natural resources districes, irrigation districts, drainage districts, and similar organizations which have authority under state law to construct, maintain, and operate works of improvement. These watershed loans are repayable over periods up to 50 years.

Rural housing loans are made for the construction of new homes and for the purchase and/or rehabilitation of existing homes. As of December 31, 1973, 500 individual loans, with an outstanding principal balance of 4.5 million dollars, have been made in the Niobrara River Basin.

6. Economic Research Service

The Economic Research Service conducts national and regional programs of research, planning, and technical consultation and services pertaining to economic and institutional factors and policy which relate to the use, conservation, development, management, and control of

natural resources. This includes determining their extent, geographic distribution, productivity, quality, and the contribution of natural resources to regional and national economic activity and growth. Also included are: resource requirements, development potentials, and resource investment economics; inpact of technological and economic change on the utilization of natural resources; resource income distribution and valuation; and the recreational use of resources. The agency also participates in departmental and inter-agency efforts to formulate policies, plans, and programs for the use, preservation, and development of natural resources.

7. Agricultural Research Service

The Agricultural Research Service conducts research aimed at finding better ways of storing, saving, transporting, and using water. It continually carries on research both on the physical requirements for, and the physical effects of soil and water conservation. The research program is oriented primarily to the needs of farmers and conservationists for scientific determination of the effectiveness and feasibility of conservation practices. A few examples of the many studies being made are: water management, including requirements and consumptive use of agricultural crops; sediment yield and delivery rates; conservation cropping systems and residue management; and the hydraulic characteristics of surface methods of irrigation.

B. Natural Resource Districts

The application of conservation practices to the land by individual landowners and operators is the largest single activity in the development and utilization of water and land resources in the basin. This program has, until recently, been in progress throughout the basin under the local direction of Soil and Water Conservation Districts. As of July 1, 1972, the Soil and Water Conservation Districts were incorporated into the Natural Resources Districts (NRD's).

The Niobrara River Basin extends across most of northern Nebraska, crossing through geographic areas having definite physical characteristics and which also vary greatly in rainfall and length of growing season. Reflecting these characteristics the 15 Soil Conservation Districts were integrated into the following three Natural Resources Districts: Upper Niobrara - White, Middle Niobrara, and Lower Niobrara Natural Resources Districts.

Aside from the division of the basin into three NRD's from west to east, and the combining of the White River Basin with the upper part of the Niobrara Basin, the north and south boundaries of the NRD's generally parallel the hydrologic boundaries of the Niobrara River Basin. In accordance with a memorandum of understanding, the Soil Conservation Service provides technical and planning assistance to individual farmers

and groups of farmers in applying conservation practices to accomplish proper land use and management.

C. Small Watershed Projects

There is one completed small watershed project, Antelope Creek, in this basin. This left-bank tributary of the Niobrara River has a drainage are of 107,000 acres and is located in Sheridan and Cherry Counties. The primary purpose of this project is flood prevention, with the major portion of the benefits being for urban protection in the city of Gordon, Nebraska.

The structural program in the watershed includes three floodwater retarding structures, controlling some 39,000 acres of drainage area and having approximately 1,300 acre feet of sediment storage and 4,800 acre feet of floodwater detention. The total installation cost for these structural measures was $343,270. The average annual cost, including operation and maintenance, is approximately $13,820. The average annual benefits for these measures were estimated to be $16,513. Construction of the project measures was completed in 1956 at a cost of $290,400.

D. Resource Conservation and Development Projects

The Nebraska Panhandle Resource Conservation and Development Project covers the eleven western-most counties of the state. It includes 2,626,100 acres of the Niobrara River Basin located in Box Butte, Dawes, Garden, Morrill, Scotts Bluff, Sheridan and Sioux Counties.

This project has proposed a wide variety of improvements to boost the economy of local communities by speeding up conservation activities through acceleration of soil surveys, encouraging land use adjustments, and promoting conservation planning; by developing and managing water resources for recreation, wildlife, agriculture, industry and municipalities; and by encouraging new industries to locate in the area to process and market products of the area. A number of these suggestions are for areas located in the Niobrara River Basin and are potentials for development by this project.

An application for the North Central Resource Conservation and Development Project has been made. The project area covers Boyd, Brown, Cherry, Holt, Keya Paha, and Rock Counties.

E. Major Storage Reservoirs

The Box Butte Reservoir in Dawes County and the Merritt Reservoir in Cherry County are the two major existing reservoirs in the basin. The primary purpose of both reservoirs is to provide irrigation storage; however, they both have recreation, fish and wildlife, and incidental flood control benefits. The Box Butte Reservoir had an initial storage capacity of about 31,100 acre feet and the initial storage capacity in the Merritt Reservoir was 74,500 acre feet. The water surface areas for these two reservoirs are 1,600 acres and 2,900 acres respectively. The irrigation details of these projects will be discussed in the "Irrigation" section of this chapter.

Four hydroelectric dams are located in the basin. Two of these are located on Minnechaduza Creek at Valentine, the third dam is located on the Niobrara River near Valentine, and the fourth is a Niobrara River installation southeast of Spencer. All four dams are direct flow installations with little or no reservoir storage located above the dams.

F. Irrigation Developments

There are two irrigation projects in the basin, the Mirage Flats Project in Dawes and Sheridan Counties, in the upper portion of the basin, and the Ainsworth Project, located in Cherry and Brown Counties.

Concrete Lined Irrigation Canal Below Merritt Reservoir

The Mirage Flats Project, constructed by the Bureau of Reclamation, began operation in 1946 and receives its water from the Box Butte Reservoir located on the Niobrara River. During the irrigation season water stored in this reservoir is released down the Niobrara River approximately seven miles to a diversion dam that diverts water through the Mirage Flats Canal to irrigate 11,660 acres of land in Sheridan County. One of the major problems encountered by this project is that often the amount of water available is inadequate to meet the needs of the developed area. The project water is supplemented by private ground-water well development.

The Ainsworth Project receives its water from the Merritt Reservoir southwest of Valentine. The reservoir is located on the Snake River with the first project water delivered through the Ainsworth Canal in 1965. When all proposed lands are developed this project will provide irrigation service to 33,960 acres of land in Brown County.

In addition to the two major irrigation projects, there are sizeable amounts of private irrigation development in the basin. Most of the private surface water development is located along the main stem of the Niobrara River and along the Keya Paha River. Ponca Creek has some surface water development; lesser amounts are located on some of the smaller tributaries in the basin. These developments all rely on the base flows of the streams for their water supply.

Most of the existing private development uses ground water for its source of water. A major part of this development is concentrated in two relatively small areas within the basin. They are in Box Butte County where development began in 1938, and in Holt County where development has expanded rapidly in recent years. Both of these areas are experiencing a decline in ground water levels. Over 1,770 irrigation wells were developed in the twelve basin counties as of 1970. Nearly 120,000 acres are reported to have an acceptable level of irrigation water management, and over 52,000 acres of land leveling for irrigation has been completed.

G. Drainage Projects

A number of small drainage developments have been installed by individual landowners to reduce crop and pasture damage in areas lacking an adequate water disposal system. In many situations the installed drainage measures also help to control flooding from abnormal rains in addition to regulating the water tables in areas having excessive wetness for agricultural production.

A major portion of the existing drainage practices have been installed in the Sandhills, where individual ranchers have constructed open drains to control water table levels in the subirrigated hay meadows.

H. National Forest

The Samuel R. McKelvie National Forest, 115,716 acres, is within the Niobrara River Basin and contains 13,000 acres of manmade forest. Established by Presidential Proclamation in 1902, it was the culmination of efforts of Dr. Charles Bessey, the eminent University of Nebraska botanist, to grow trees and even a forest on the Great Plains. This area continues to be developed under multiple use management to meet increasing demands for recreation, hunting, grazing, wildlife habitat, and other forest and range uses.

I. National Wildlife Refuges

The Bureau of Sport Fisheries and Wildlife, Department of Interior, controls and manages the Valentine and Fort Niobrara National Wildlife Refuges in Cherry County, near Valentine, Nebraska.

The Valentine National Wildlife Refuge, located on the southern drainage boundary of the Niobrara River Basin, is a wildlife refuge managed primarily for waterfowl. Numerous sandhill lakes are in the refuge; however, the vast majority of the total area is upland grasslands. In addition to waterfowl, this refuge has a substantial population of prairie grouse and a huntable population of deer. It provides an excellent opportunity for public fishing and, in recent years, hunting has been permitted for upland game and big game in designated areas during periods when the activity does not conflict with the management as a waterfowl refuge.

The Fort Niobrara National Wildlife Refuge features an exhibition of wildlife species in a natural grasslands habitat. Species of major interest include buffalo, elk, prairie dogs, and longhorn cattle. Thus, the primary value of this area for outdoor recreation is sightseeing and natural history.

J. National Monuments

The National Park Service administers the Agate Fossil Beds National Monument which is the only unit of the National Park System in the Niobrara River Basin. The Monument, consisting of 3,150 acres, was established in June 1965 to protect and conserve its outstanding natural historical features and its research and recreational opportunities. Paleontologists describe the area as "a natural depository of traces of an animal community that flourished twenty million years ago, offering a glimpse of strange creatures, long extinct". Since 1900 many fossils have been removed and assembled for natural history collections in universities and natural museums. The National Park Service plans to expose representative fossil remains where visitors will be able to see the fossil skeletons of many creatures where they were buried millions of years ago.

K. Fish Hatcheries

Two facilities that assist in fish production are located in the basin. They are the Valentine Fish Hatchery at Valentine and the Grove Lake Trout Rearing Station near Royal, Nebraska.

The Valentine Fish Hatchery is the largest warm water hatchery in the state. Trout hatched at the Federal Fish Hatchery in Crawford, Nebraska are held here for rearing and distribution to points in the northern part of the state. Also distribution of other species, such as large mouth bass, rock bass, and coho salmon is made in this area. This hatchery is a spawn producing station for northern pike, shipping eggs to other state and federal hatcheries. It also does experimental work with Sacramento perch, white perch, and redear sunfish.

The Grove Lake Trout Rearing Station nurses trout fingerlings until they are stocked in areas both inside and outside the basin. Currently, ten rearing ponds are located at this facility with two raceways brought into operation this year and two more planned for 1972.

L. Other Recreation, Fish and Wildlife Areas

A number of recreation and fish and wildlife developments are in the basin. Most of these facilities are owned by federal, state, and local entities of government; however, numerous improvements have been made in the private sector to satisfy much of the recreational demand for this basin. This is especially true of hunting where the demand is primarily supplied on private lands.

At the present time, 20 nonurban public recreational areas exist in the basin. Sixteen of these developments are owned or leased by the Nebraska Game and Parks Commission, including one state park, one state wayside area, four state recreation areas, and ten special use areas. A total of 19,509 acres of area are involved in these developments. The type of area and the facilities available at each of the four state groupings is explained in the following four paragraphs.

A state park is defined as an area having significant statewide scenic, scientific, or historic interest with a complete development potential. Niobrara State Park is the only existing development in the basin that is classified as a state park.

A state wayside area is defined as an area appropriate in size and location adjacent to main traveled highways which provides safe rest and picnic stops for travelers. These areas are selected for scenic or historical interest, when possible, and developed with such facilities as needed for the purpose intended.

State recreation areas have primary value for day use, but with secondary value as overnight use facilities. Most of these basic water resources are suitable for water oriented activity.

Valentine National
Wildlife Refuge

Habitat Varies
from Wetlands
to Upland Range

Nebraska Game and Parks Commission

Fort Niobrara National
Wildlife Refuge

Nebraska Game & Parks Commission Photo's

Longhorn Cattle and Elk Roam the Hills of
the Fort Niobrara National Wildlife Refuge

State special use areas are primarily for public hunting, fishing or other wildlife. They include such areas as wildlife refuges, game management areas, access sites to reservoirs or rivers, and natural areas which have not been developed for day use.

In addition to the developments provided by the State of Nebraska. the Bureau of Sport Fisheries and Wildlife controls and manages two National Wildlife Refuges. These areas have already been discussed in greater detail in a previous section of this chapter. The National Park Service owns and manages the Agate Fossil Beds National Monument and the Forest Service administers the Samuel R. McKelvie National Forest. Both of these areas have already been discussed in this chapter.

At the present time there are about 229,000 acres of nonurban public recreational area in existing outdoor recreation developments. This includes all of the Valentine National Wildlife Refuge which actually has about one-fourth of its area located in the Loup River Basin. Of the total area developed for public recreation, 92 percent is land, one percent is wetland, and seven percent is water. Table VI-1 shows in detail the type of area and its developed classification for each type of development.

TABLE VI-1.--EXISTING NONURBAN PUBLIC RECREATION AREAS
NIOBRARA RIVER BASIN, NEBRASKA

Type of Developments	No.	Type of Area			Total Area	Recreation Type 1/		
		Land	Wet-land	Water		I	II	III
		(Acres)						
State								
Special use Areas	10	5,360	315	1,782	7,457	-	288	7,169
Recreation Areas	4	7,019	-	4,616	11,635	-	805	10,830
Wayside Areas	1	9	-	-	9	9	-	-
Parks	1	405	-	3	408	-	408	-
Subtotal	(16)	(12,793)	(315)	(6,401)	(19,509)	(9)	(1,501)	(17,999)
National Wildlife Refuges 2/	2	79,566	1,633	9,271	90,470	-	-	90,470
Monument	1	3,150	-	-	3,150	-	-	3,150
Forest	1	115,716	-	-	115,716	-	-	115,716
TOTAL	20	211,225	1,948	15,672	228,845	9	1,501	227,335

1/ Class I - High Density Recreation
Class II - General Outdoor Recreation
Class III - Natural Environment

2/ Part of the Valentine National Wildlife Refuge is located in the Loup River Basin

Other recreational lands include the area owned or administered by municipalities. These lands are located in city parks, swimming pools, golf courses, playgrounds, and athletic fields and supply a major part of the day use recreation for each local area. Additional developments provided by clubs or other private organizations and private enterprise all contribute to the basin's total recreation resources. Private landowners have constructed numerous farm ponds which provide incidental recreation for both hunting and fishing. About 300 acres of cropland have been converted to wildlife-recreation uses. Also nearly 17,000 acres of farmstead and feedlot windbreaks and over 5,000,000 feet of field windbreaks have been established which are used for the above purposes. A major portion of the existing hunting supply is that provided on private lands.

The Niobrara Basin and areas adjacent to the basin are rich in historic sites.1/ Numerous Indian village sites are situated in the area. Other sites, by county, include:

Box Butte - Robert Ball Anderson Homestead near Hemingford
Carpenter Sod House near Hemingford
Running Water Stage Station near Marsland

Boyd - Log Cabin near Butte
Round Barn near Spencer

Brown - Log Cabin near Ainsworth

Cherry - Fort Niobrara at Valentine
Old Newman Ranch near Gordon

Dawes - Dunlap Flour Mill and Cheese Factory on site of former town of Dunlap
- Belmont Tunnel north of Belmont, only R.R. tunnel in Nebraska

Knox - Bruns House in Niobrara
Sandoz Cabin southeast of Verdigre
Verdigre Flour Mill in Verdigre

Sheridan - Ghost Town near Antioch
Old Jules Sandoz Homesite and Orchard on Niobrara River south of Hay Springs
Bressee Potato Elevator in Rushville
Star Mill, an extinct flour and feed mill in Rushville

Sioux - Agate Fossil Beds National Monument near Agate

1/ Historic Preservation in Nebraska, Nebraska State Historical Society, Lincoln, Nebraska

M. Rural and Urban Electrification

Most electrical utilities in Nebraska are publicly owned. Every utility organization (district) is a political subdivision of the state, the directors of each being elected by public ballot, except for three cooperatives, whose directors are elected by the cooperative membership.

The Enabling Act legislation, passed by the Nebraska Legislature in 1933 and which followed previous similar legislation, set up statutory machinery for organizing most of today's rural electric systems in Nebraska as public power districts. Congress, under the Rural Electrification Act of 1936, provided technical and financial assistance from the Rural Electric Administration to rural groups to organize and to build their own rural electrical distribution systems to supply rural areas. Today these distribution systems in Nebraska are now known as power districts or cooperatives. Rural public power districts either purchase their power directly from large wholesale suppliers, or buy through contracting firms which act as purchasing agents.

Most Nebraska towns over 2,500 in population have municipal power distribution systems. Towns of around 2,500 in size, however, usually purchase electricity direct from either the Tri-State Electric Generation and Transmission Association or one of the distribution districts. All municipal systems also have the right to generate their own electricity. Smaller towns, because they are classified as rural, are usually supplied by rural systems.

The electrical power situation in the Niobrara Basin is generally similar to that which prevails over Nebraska. In 1934, only 7.1 percent of Nebraska's farms had electric service. By 1969, 98.3 percent of Nebraska's farms and ranches had electric service, nearly all of which is supplied through public power districts or cooperatives.

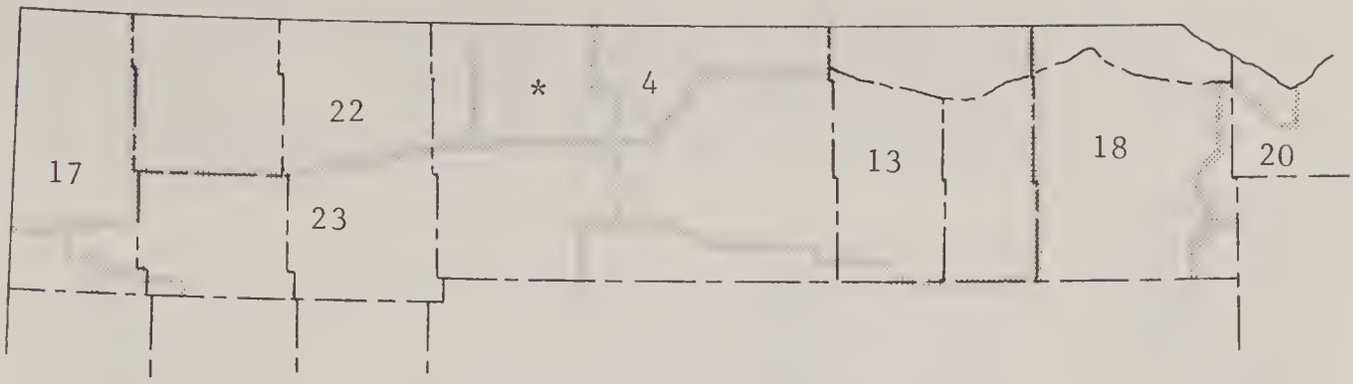
Now the task is to meet the increasing demand, doubling about every seven years, of rural people for more electric power. Meeting this increasing demand calls for heavier lines, the replacement of substations, and the finding of new sources of power.

The Niobrara Basin is basically supplied with electrical energy by seven rural electric systems. The upper part of the basin west of Kilgore in Cherry County is supplied by three rural systems which contract for electric power through the Tri-State Electrical Generation and Transmission Association which obtains its power from Colorado. The lower part of the basin is supplied by four other rural systems which obtain their power from Nebraska Public Power District in eastern Nebraska (Figure VI-1).

N. Municipal and Industrial Water Supply Developments

Twenty-five of the 32 incorporated communities in the basin are

Figure VI-1.--RURAL ELECTRIC SYSTEMS
NIOBRARA RIVER BASIN COUNTIES, NEBRASKA



* -- LaCrosse Creek Electric Association, Martin, South Dakota
4 -- Cherry-Todd Electric Cooperative Inc., Mission, South Dakota
13 -- KBR Rural Power District, Ainsworth, Nebraska
17 -- Niobrara Electric Association, Inc., Lusk, Wyoming
18 -- Niobrara Valley Electric Membership Corporation, O'Neill, Nebr.
20 -- North Central Public Power District, Creighton, Nebraska
22 -- Northwest Rural Public Power District, Hay Springs, Nebraska
23 -- Panhandle Rural Electric Membership Association, Alliance, Nebr.

supplied by a municipal water system. The 1970 census shows that 21,051 people live in these 25 communities, with 9,524 located in the two urban areas greater than 2,500 and 11,527 residing in the 23 rural communities that are under 2,500. The remaining seven incorporated communities have individual water systems with 228 inhabitants living in these villages. There are 18,050 people located in rural households that are also supplied by individual water systems. These rural households include the population located in unincorporated communities and and those living in farm and nonfarm households. A grouping of the existing water supply developments, using 1970 population data, is shown in Table VI-2.

O. Municipal and Industrial Sewage Treatment Developments

Seventeen of the 32 incorporated urban and rural communities in the basin have municipal waste treatment systems. These sewage treatment facilities provide a central waste disposal service to 20,222 residents. The remaining 14 incorporated areas, the unincorporated communities, and the rural farm and nonfarm households are supplied by individual treatment facilities. A total of 19,107 residents are served by these developments. A grouping of the existing sewage treatment developments, using 1970 population data, is shown in Table VI-3.

Table VI-2.--MUNICIPAL AND RURAL DOMESTIC WATER SUPPLY DEVELOPMENTS, 1970, NIOBRARA RIVER BASIN, NEBRASKA

Category	Municipal Water Systems		Individual Water Systems		Totals	
	Places	Pop. 1/	Places	Pop. 1/	Places	Pop. 1/
Incorporated Communities						
Over 2,500	2	9,524			2	9,524
1,000-2,500	3	5,316			3	5,316
500-1,000	5	3,167			5	3,167
250-500	5	1,842			5	1,842
Under 250	10	1,202	7	228	17	1,430
Subtotal	(25)	(21,051)	(7)	(228)	(32)	(21,279)
Rural Households 2/			-	18,050	-	18,050
TOTAL BASIN	25	21,051	7	18,278	32	39,329

1/ 1970 census data
2/ Includes unincorporated communities

TABLE VI-3.--MUNICIPAL AND RURAL DOMESTIC SEWAGE TREATMENT DEVELOPMENTS, 1970 NIOBRARA RIVER BASIN, NEBRASKA

Category	Municipal Waste Treatment Systems		Individual Waste Treatment Facilities		Totals	
	Places	Pop. 1/	Places	Pop. 1/	Places	Pop. 1/
Incorporated Communities						
Over 2,500	2	9,524			2	9,524
1,000-2,500	3	5,316			3	5,316
500-1,000	5	3,167			5	3,167
250-500	5	1,842			5	1,842
Under 250	2	373	15	1,057	17	1,430
Subtotal	(17)	(20,222)	(15)	(1,057)	(32)	(21,279)
Rural Households 2/			-	18,050	-	18,050
TOTAL BASIN	17	20,222	15	19,107	32	39,329

1/ 1970 census data
2/ Includes unincorporated communities

P. Rural Water Districts

The Boyd County Rural Water District No. 1 was organized to provide domestic and livestock water supplies where ground water supplies are inadequate. The distribution system for this project is now under construction.

VII. WATER AND RELATED LAND RESOURCE DEVELOPMENT POTENTIAL

The water and land resources of the basin have varied capabilities to supply needed resource development. This chapter discusses the physical potentials for water and related land development to meet identifiable needs.

A. Availability of Land

Sufficient land is available to allow attainment of a wide range of alternate goals. Only a small amount of land will be needed for increased nonagricultural uses. Additional land for new urban and built-up areas can readily be converted from existing agricultural land.

There is considerable potential for land use conversion. There are about a million acres in Land Capability Classes I, II, and III presently used for pasture and range. Much of this could be converted to cropland if needed for increased farm efficiency or national production needs. Some 76,000 acres are in Classes V and VI and are currently used as cropland. This land should be seeded to a permanent cover of grass or trees. Good management and proper land use would permit increased production of crops and livestock and still permit use of the land according to its capabilities.

B. Impoundments

The potential for the installation of upstream reservoirs varies considerably in this basin. A wide range in climatic conditions, topography, and soil conditions are major factors in determining the physical potential for water impoundments.

The potential for upstream reservoirs above Box Butte Reservoir, made without consideration of economic limitations, is limited by existing legal water rights that result in competition for waters that are over appropriated during some seasons of the year. During seasons of above normal flow, part of the base flow can be stored in reservoirs, and flood waters can be freely stored during any season. However, during seasons of below normal stream flow, shortages must be tolerated by some users to insure adequate supply to those with older water rights.

Because of the water rights situation, the major storage potential for upstream reservoirs is limited to the lower third of the basin. An exception would be on some of the left bank tributaries directly below

Box Butte Reservor, where soil conditions and topography are suitable for the installation of impoundments. Sites having adequate storage capacity for the temporary storage of flood runoff are available. They would reduce the delivery of sediment to downstream areas. They could also store runoff for irrigation use and could be developed for recreation or fish and wildlife. Any use of these sites would have to be economically justified before they could be considered for development. Upstream reservoir storage potentials identified in this study for each watershed in the basin are shown in Table VII-1.

Table VII-1.--UPSTREAM RESERVOIR STORAGE POTENTIAL
NIOBRARA RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Watershed Drainage Area	Potential Reservoirs	Area Controlled	Storage Capacity			
Number	Name				Sediment	Other 1/	Floodwater	Total
		(Acres)	(Number)	(Acres)	(Acre Feet)			
28 - 2	Von Tassell Creek	11,700	0	-				
28 - 3	Niobrara-Harrison	100,100	0	-				
28 - 4	Niobrara-Agate	167,700	0	-				
28 - 5	Whistle Creek	95,400	0	-				
28 - 6	Niobrara- Marsland	210,100	0	-				
28 - 7	Sand Creek	75,400	0	-				
28 - 8	Dunlap Tribs	125,800	3	64,000	4,000	4,500	8,000	16,500
28 - 9	Mirage Flats	114,900	2	23,000	1,440	1,600	2,880	5,920
28 -10	Box Butte Creek	158,700	0	-				
28 -11	Upper Snake Creek	184,300	0	-				
28 -12	Point of Rocks Creek	95,500	0	-				
28 -13	Berea-Hemingford Creeks	117,200	0	-				
28 -14	Lower Snake Creek	218,400	0	-				
28 -15	Rush Creek	142,900	0	-				
28 -16	Niobrara-Sheridan Tribs	75,700	0	-				
28 -17	Antelope Creek 2/	107,000	3	39,000	1,269	-	4,842	6,111
28 -18	Niobrara Sandhills	2,648,200	0	-				
28 -19	Minnechaduza Creek	162,300	0	-				
28 -20	Niobrara Tribs (Cherry-Keya Paha)	118,600	0	-				
28 -21	Upper Plum Creek	200,600	0	-				
28 -22	Lower Plum Creek	90,400	0	-				
28 -23	Bone Creek	126,800	2	64,000	5,330	19,500	10,670	35,500
28 -24	Long Pine Creek	166,300	1	70,000	5,830	18,200	11,670	35,700
28 -25	Riverview Tribs	106,700	0	-				
28 -26	Mariaville Tribs	179,000	0	-				
28 -27	Big Sandy-Brush Creek	142,600	2	80,000	6,670	23,100	13,340	43,110
28 -28	Turkey Creek Tribs	77,700	0	-				
28 -29	Eagle Creek	132,300	1	83,000	8,650	23,800	13,830	46,280
28 -30	Redbird Creek	104,100	1	77,000	8,030	22,100	12,840	42,970
28 -31	Upper Verdigre Creek	207,200	4	132,000	16,500	43,400	22,000	81,900
28 -32	North Branch Verdigre Cr.	93,400	1	68,000	5,670	20,800	11,340	37,810
28 -33	Lower Verdigre Creek	53,800	2	26,000	4,330	8,200	4,330	16,860
28 -34	Lower Niobrara River	137,400	0	-				
28a- 2	Sandy Shady Creek	47,400	0	-				
28a- 3	Lost-Holt	142,800	1	59,000	6,150	6,700	9,830	22,680
28a- 4	Burton-Spring	121,500	2	77,000	8,030	12,400	12,840	33,270
28a- 5	Keya Paha Tribs (Lower)	106,500	1	16,000	1,670	3,000	2,670	7,340
27 - 2	Ponca Creek	14,800						
27 - 3	Ponca Creek (Middle)	110,000	23	133,000	7,200	17,100	18,660	42,960
27 - 4	Ponca Creek (Lower)	153,400						
	TOTAL	7,444,600	49	1,011,000	90,769	224,400	159,742	474,911

1/ Adjusted mean annual yield minus evaporation and seepage loss.
2/ Existing watershed development.

The total identified potential for upstream project-type reservoir storage is estimated to be about 475,000 acre feet. Of this amount, 91,000 acre feet would be needed for sediment storage, 160,000 acre feet for floodwater storage, and some 224,000 acre feet remaining would be available for other beneficial uses. The additional storage capacity is equivalent to the mean annual yield from the controlled drainage area minus evaporation and seepage.

In addition to the identified upstream project-type reservoirs, considerable potential exists for many smaller impoundments that will satisfy on-farm and local needs for livestock water, grade stabilization, irrigation, and floodwater and sediment detention. These smaller reservoirs could also have incidental benefits for recreation, fish and wildlife, and ground water recharge. No estimate has been made of the total potential storage capacity in small reservoirs.

The land rights required to permit construction of many of the potential upstream multi-purpose reservoirs must be acquired either by easement or by acquiring title to the land. Some reservoir sites have farmsteads and other improvements in the areas that would be inundated. Other sites have roads and railroad tracks that would have to be modified, closed, or relocated. In some situations, public utilities and pipelines would also be affected. All of these factors add to the total installation costs for the potential reservoirs.

The location of potential upstream project-type reservoirs was made with only limited field investigations. In many instances sites were selected from existing soil survey and topographic maps. Estimates were then made of the storage required to meet all potential needs without specifically designating an actual location. Detailed studies during individual project formulation will determine the actual sites that will best satisfy the multi-purpose needs for the area.

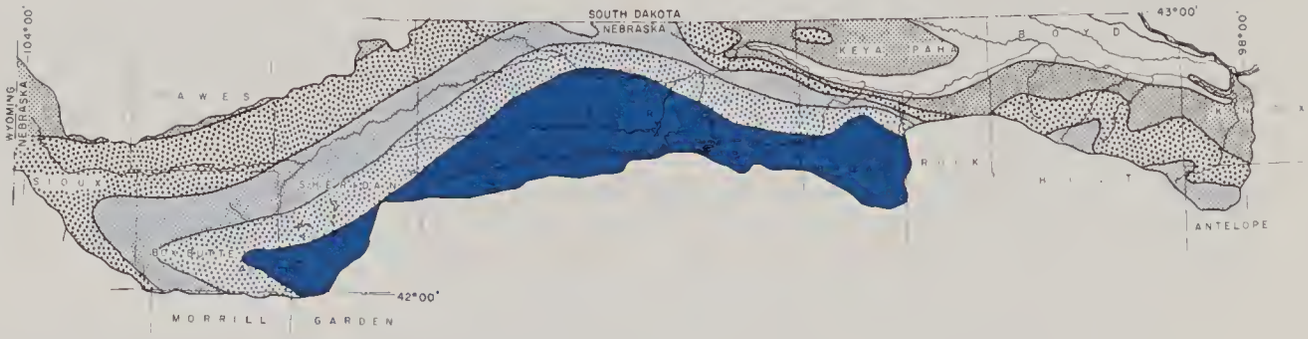
C. Ground Water Development

There is a considerable potential for additional ground water development. Basinwide the current annual withdrawal is estimated to be from 20 to 25 percent of the total natural recharge. In the Sandhills portion of the basin, the natural recharge surfaces as small lakes and flowing streams.

Potential development of the ground water reservoir will be a local consideration from a supply viewpoint. The volume and location of the ground water in storage (Figure VII-1) must be compatible with expected usage.

The portion of the basin comprised of Sioux, Dawes, Box Butte, and Sheridan (north of the river) Counties is capable of yielding medium to large capacity wells (200 to 500 gpm) on a sustained basis. Lifts are ordinarily great because depth to water exceeds 200 feet in much of the area and large yields are often accompanied by large water level drawdowns.

Figure VII-1 GROUND WATER IN STORAGE
NIOBRARA RIVER BASIN, NEBRASKA



LEGEND

FEET OF WATER

- 80 TO 100
- 60 TO 80
- 40 TO 60
- 20 TO 40
- 4 TO 20
- 0 TO 4

NOTE
A STORAGE COEFFICIENT OF 0.20 WAS ASSUMED FOR VOLUME ESTIMATES, THAT IS, EACH FOOT OF WATER REPRESENTS 5 FEET OF PERMEABLE WATER-BEARING MATERIAL COMPOSED OF PLEISTOCENE, PLIOCENE AND MIOCENE DEPOSITS OF THE PRINCIPAL RESERVOIR

SOURCE:
CONSERVATION AND SURVEY DIVISION, U. OF N

Figure VII-2 GROUND WATER QUALITY
NIOBRARA RIVER BASIN, NEBRASKA

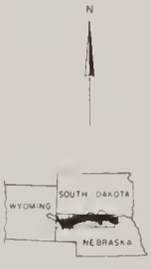
LEGEND

TOTAL DISSOLVED SOLIDS CONCENTRATION IN MILLIGRAMS PER LITER

- LESS THAN 170
- 170 TO 400
- 400 TO 700
- MORE THAN 700

NOTE
SAMPLES TAKEN FROM WELLS GENERALLY LESS THAN 400 FEET DEEP

DATA SOURCES.
U.S. GEOLOGICAL SURVEY
COLLEGE OF AG., U. OF N
CONS & SURVEY DIV., U. OF N
NEBRASKA DEPT. OF HEALTH



SCALE 10 0 10 20 30 40 MILES
1/3,480,000

SOURCE:
SCS DRAWING 5,S-28978 AND
INFORMATION FROM FIELD TECHNICIANS
LAMBERT CONFORMAL CONIC PROJECTION

10-6-72
5,S-30799

USDA-SCS-LINCOLN, NEBR. 1972

Knox, Boyd, and Keya Paha Counties comprise an area capable of producing only low to medium capacity wells (50 to 200 gpm) on a sustained basis. Supply is from a highly mineralized source in some of the area and potential development will be somewhat limited. Larger quantities of good quality water are available in the alluvial valleys.

Anticipated development includes a continued increase in irrigation wells as well as additional ones for rural domestic, livestock, municipal, recreation, and industrial use. Generally projected demands by all users, except irrigation, can be easily satisfied. Further irrigation development in Box Butte and Holt Counties will continue to mine the ground water supply. A recent assessment of the Alliance area, in Box Butte County, indicates a probable continued lowering of the water table of about one foot per year. This assumes no further development of lands for irrigation.

The sandy upland soils of the basin are ideally suited for maximum infiltration. Artificial recharge is technically feasible in concept. However, successful ground water recharge requires sufficient quantities of replacement water be available and the recharge water quality be compatible with the water in the depleted acquifer. See Figure VII-2.

D. Channel Improvement

A potential for channel improvement exists in a number of areas in the basin. These areas vary from cropland, where production is limited by excess surface water, to pastures or hay meadows that have potential for conversion to cropland.

In the cropland areas, channel improvement is necessary to provide adequate drainage to remove the excess surface water from normal precipitation within a time that will keep damages at a minimum. In some areas multi-purpose channels may be needed to remove the runoff from abnormally high precipitation events. In many cases these channels can also be used for irrigation waste water disposal systems.

Some pasture and subirrigated hay meadow areas can be improved by altering the seasonal flow conditions of existing channels to enhance production. Other areas may require complete drainage systems if the lands are to be cropped. The design of such systems will depend on existing soil condition, topography, and the desired land use. On-farm land leveling and other drainage measures may be required in addition to the channel improvement measures.

E. Gully and Streambank Stabilization

There is a significant potential for gully and streambank stabilization in some areas of the basin. The minimum level of stabilization is that necessary to prevent the deterioration of the agricultural land located in the path of advancing gullies or subject to streambank

erosion. In some situations, the potential also exists to restore lands that have already been voided or depreciated by these types of erosion.

In addition to preventing the destruction of the land resource, the potential exists to reduce damages to improvements such as roads, bridges, buildings, and fences located on affected lands. Potential land stabilization will also reduce the production of damaging sediment which effects downstream landowners, communities, and the public-at-large.

A major portion of the gully erosion problems can be controlled by installing on-farm land treatment measures. Effective measures to control gully overfalls and degrading channels include drop inlets, chutes, and drop spillway structures. Other measures to control and stabilize watercourses and channels include diversions, grassed waterways, tree plantings, sloping of channel banks, installation of channel linings, and the use of jetties, deflectors, and riprap.

In some areas in the basin there is potential for grade stabilization by project-type measures. This is generally limited to the more serious erosion problems involving two or more landowners with the type of measures needed the same as, but on a larger scale than, those used to treat the smaller problems.

F. Water Table Control

There is potential for extensive water table control in at least two areas in the basin. Both of these areas at present are experiencing a falling water table with control dependent on bringing in supplemental water from an outside source. This supplemental water would stabilize the water table at a desirable level by replacing some of the ground water used by irrigation.

One area which appears to have some potential to control water table levels is in the irrigated areas around Alliance, in Box Butte County. Currently, there is no surface water supply available within a reasonable distance of this area. However, ground water that offers an adequate supply to meet future needs does exist in the western edge of the Sandhills. Although extensive investigation would be required, it appears that a well field could be developed to pump ground water 20 to 40 miles westward from this area to the area of decline around Alliance.

The other major areas in the basin having potential for water table control is the O'Neill-Atkinson area in Holt County. This area is also experiencing a falling water table from extensive ground water irrigation development. The Bureau of Reclamation has completed a feasibility investigation for this area using supplemental surface water supplies from the Niobrara River and has submitted a favorable report to the Congress where it is under consideration for authorization.

G. Irrigation

A number of factors were considered in evaluating the irrigation potential for this basin; probably the most important is the availability of suitable land and water. There are relatively large amounts of land and water in this basin suitable for irrigation. The limiting physical factor in future development is getting the available water to the most suitable land.

At the present time, both ground and surface water supplies are available for additional development. Usually the source of supply and its location relative to suitable land determines if there is potential for private or project-type irrigation.

In this study the potentially irrigable land was estimates to total nearly 428,700 acres, including some 145,000 acres presently irrigated. The potential acreage is shown in Table VII-2 for each delineated watershed in the basin. To achieve this potential, both private and project-type development will be required, using both ground and surface water supplies. These water supplies would need to be integrated into a system that will best utilize the total water supply available.

Major project-type surface irrigation developments were not evaluated in this cooperative study. The projected development for this report was limited to private irrigation development. It is estimated that an additional 160,000 acres of private irrigation will be developed by 2020.

The location of the projected private irrigation development is not uniformly distributed in this basin. Currently, there are two areas where considerable private well-type irrigation has been developed. They are the Alliance area in Box Butte County and the O'Neill-Atkinson area in Holt County. Currently both of these areas are experiencing a falling water table. Since existing water laws do not forbid the installation of additional wells, it is anticipated considerable additional development will take place in these areas. Development of the maximum potential for either of these areas will eventually require water from outside the area of use.

Private irrigation development has a potential in a number of other areas in the basin. Some ground water development potential exists in the western portion of the basin, with additional amounts located in the Sandhills. If farmer ingenuity and technology can overcome some of the problems associated with irrigation, it is likely that a much larger acreage of the Sandhills may be placed under well irrigation.

There is also a limited potential for private irrigation development by storing surface flows in small private irrigation reservoirs. These reservoirs could be filled from surface runoff or by pumping from off-season base flows of larger streams. One area with this potential is in the Keya Paha drainage area. Feasibility for this type of development is questionable and will need to be considered for each individual installation.

Table VII-2.--SUMMARY OF POTENTIALLY IRRIGABLE LAND
NIOBRARA RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Drainage Area	Potentially Irrigable 1/
Number	Name	(Acres)	
28 - 2	Van Tassell Creek	11,700	0
28 - 3	Niobrara-Harrison	100,100	9,000
28 - 4	Niobrara-Agate	167,700	5,000
28 - 5	Whistle Creek	95,400	5,000
28 - 6	Niobrara-Marsland	210,100	10,000
28 - 7	Sand Creek	75,400	4,500
28 - 8	Dunlap Tribs	125,800	15,000
28 - 9	Mirage Flats	114,900	21,000
28 -10	Box Butte Creek	158,700	8,000
28 -11	Snake Creek (Upper)	184,300	1,000
28 -12	Point of Rocks Creek	95,500	15,000
28 -13	Berea-Hemingford Creeks	117,200	30,000
28 -14	Snake Creek (Lower)	218,400	20,000
28 -15	Rush Creek	142,900	2,500
28 -16	Niobrara-Sheridan Tribs	75,700	2,500
28 -17	Antelope Creek	107,000	10,000
28 -18	Niobrara Sandhills	2,648,200	22,000
28 -19	Minnechaduza Creek	162,300	2,500
28 -20	Niobrara Tribs (Cherry-Keya Paha)	118,600	1,400
28 -21	Plum Creek (Upper)	200,600	10,000
28 -22	Plum Creek (Lower)	90,400	8,000
28 -23	Bone Creek	126,800	26,000
28 -24	Long Pine Creek	166,300	6,000
28 -25	Riverview Tribs	106,700	1,600
28 -26	Mariaville Tribs	179,000	6,500
28 -27	Big Sandy-Brush Creek	142,600	40,000
28 -28	Turkey Creek Tribs	77,700	1,800
28 -29	Eagle Creek	132,300	40,000
28 -30	Redbird Creek	104,100	30,000
28 -31	Verdigre Creek (Upper)	207,200	19,000
28 -32	North Branch Verdigre Creek	93,400	40,000
28 -33	Verdigre Creek (Lower)	53,800	500
28 -34	Niobrara River (Lower)	137,400	5,700
28a- 2	Sandy Shady Creek	47,400	2,000
28a- 3	Lost-Holt	142,800	2,000
28a- 4	Burton-Spring	121,500	3,000
28a- 5	Keya Paha Tribs (Lower)	106,500	1,600
27 - 2	Ponca Creek	14,800	0
27 - 3	Ponca Creek (Middle)	110,000	300
27 - 4	Ponca Creek (Lower)	153,400	300
	TOTAL	7,444,600	428,700

1/ Includes some 145,000 acres of presently irrigated land.

H. Recreation, Fish and Wildlife

An excellent potential exists for both recreation and fish and wildlife development in the basin. The Niobrara River itself offers one of the most scenic, wild, and undisturbed areas in the state. This natural river environment provides unique recreation potential such as canoeing, river floating, fishing, and sightseeing of a quality not found in other areas of the state. Future development in the basin should insure the lasting quality of this environment. The two specific areas considered to have the greatest potential for designation and inclusion in the National Wild, Scenic and Recreation Rivers System are: (1) the reach of the Niobrara River extending downstream from the confluence of Antelope Creek to the headwaters of the proposed Norden Reservoir including eight miles of the Snake River downstream from Merritt Dam; and (2) Snake River from its headwaters to

Merritt Reservoir. These reaches possess the qualities of free flowing streams with shorelines and riparian vegetation in an unaltered, undeveloped state. These areas constitute a transition zone of eastern to western species of trees, shrubs, grasses, birds and animals.

The upstream reservoir storage potential previously discussed could supply over 30,000 acres of water surface area for recreation and/or fish and wildlife development. These impoundments could also provide for water-based recreational activities such as fishing, boating, and water skiing. Adjacent lands with facilities for camping, picnicking, and hiking could supplement the water-based recreation. Additional areas of undeveloped lands which are conducive to wildlife habitat and the total recreational environment could enhance the reservoirs.

An increase in fishing potential can also be accomplished by improved access to existing Sandhill lakes, streams, reservoirs, and ponds. Since most of these fishing areas are located on private land, some type of financial assistance to landowners will be required to increase the access to them.

Since over 95 percent of the basin is privately owned, most of the increase in hunting potential is on privately owned land. To improve this potential, some type of economic incentive will be required to motivate private landowners to develop the necessary habitat to increase wildlife production and provide the access needed so that a greater part of the hunting demand can be met.

There also is potential to provide additional recreational output by increased public support of existing recreation and parks programs. Increased financial support could make possible a more diversified recreation program and provide more adequate maintenance of park facilities.

I. Water Quality Control

As the basin's population and productivity increase, both surface and ground waters will be used more intensively and water quality problems can be expected to increase. There is definitely a potential for maintaining and improving the quality of the basin's waters, especially in the tributary streams.

Adequate improvements and enlargements to municipal and industrial waste treatment systems are readily responsive to designated need. The potential for accomplishment of such improvements is dependent more on available financing than on design and construction. This is partially true for the control of agricultural wastes also. Land conservation measures can reduce the volume of overland runoff and the associated debris, sediment, and chemical residues. However, unless a significant volume of water is forever detained, total sediment volumes carried by perennial streams are not materially reduced. This will be especially true in a basin as large as that drained by the Niobrara River and its

A Solution to Improve Water Quality

tributaries. Beneficial results can be obtained by improving the control, selection and use of agricultural chemicals and also by minimizing feedlot runoff.

J. Associated Land Treatment and Adjustments

Potentially, every acre of agricultural land could be used in accordance with its greatest capability, and could be treated in accordance with its need. It is reasonable to expect that desired land treatment and proper land use will be less than the ideal goal because of such factors as land ownership changes, depreciation of mechanical practices, and lag in application of conservation practices. The current status and projected land treatment expected to be installed and soil loss on agricultural land in the basin by 2020 is shown in Table VII-3.

It is projected that some 1,195,000 additional acres of agricultural land will be adequately treated by 2020, bringing the total land with adequate treatment to over 4,985,000 acres, or 70 percent of the agricultural land. About 490,000 acres will be treated using only management practices and 705,000 acres will have both management and more intensive practices to be adequately treated.

By 2020, it is projected that 518,000 more acres of cropland will be adequately treated with the total acreage adequately treated reaching 964,000 acres, or 72 percent of the total cropland. Approximately 363,000 acres of the new area treated with required both management and vegetative or mechanical practices, with the remaining 155,000 acres

Table VII-3.--CURRENT AND PROJECTED STATUS OF AGRICULTURAL LAND TREATMENT AND SOIL LOSS
NIOBRARA RIVER BASIN, NEBRASKA

Land Use	Projected Basin Acreage 2020	Current Adequate Treatment	Projected Land Treatment			Proj. Adequate Treat. by 2020		Soil Loss by 2020	
			Proper Mgmt.: & Veg. or Mech. Prac.	Proper Mgmt.: Pract.	Sub-Total	Total	Percent		
	(1,000 Acres)						%	Tons/Yr. (000)	Ton/Ac./Yr.
Cropland									
Nonirr.	1,029	411	29	280	309	720	70	2,058	2.0
Irr.	305	35	126	83	209	244	80	152	0.5
Sub-Total	(1,334)	(446)	(155)	(363)	(518)	(964)	(72)	(2,210)	(1.7)
Pasture & Range	5,572	3,295	305	300	605	3,900	70	3,900	0.7
Forest & Woodland	119	22	22	33	55	77	65	17	0.1
Other Ag. Land	49	27	8	9	17	44	90	44	0.9
TOTAL AG. LAND	7,074	3,790	490	705	1,195	4,985	70	6,171	0.9

needing only management practices. The acreage of irrigated cropland is projected to more than double by 2020. Most of this increase will come from the conversion of nonirrigated cropland to irrigated cropland. An estimated 209,000 acres of the new and existing irrigation area is projected for treatment during this period.

About 605,000 additional acres of pasture and range will be adequately treated during the projection period, with the total area adequately treated by 2020 being some 3,900,000 acres (70 percent of the total pasture and range area).

Projections for the treatment of forest and woodland are influenced by the degree of economic opportunity to be provided by the production of forest products. Estimates are that only 65 percent of forest and woodland area will be adequately treated by 2020. This includes planting of trees in windbreaks to provide protection for farmsteads, feedlots, and wildlife, and in other limited areas that will be utilized for the production of forest products.

An additional 17,000 acres of other agricultural land will be adequately treated by 2020, with the total area adequately treated reaching 44,000 acres, or 90 percent of this land use.

Soil losses from agricultural land in 2020 are projected to be about 6.2 million tons, averaging about 0.9 tons per acre. Of this amount 2.2 million tons of soil loss will occur on cropland, averaging about 1.7 tons per acre. Pasture and range loss will be about 3.9 million tons, averaging 0.7 tons per acre annually on the 5,572,000 acres of grasslands. Rates of soil losses on forested land and other agricultural

land is projected to be 0.1 and 0.9 tons respectively.

K. Nonstructural Measures for Reduction of Flood Damages

Nonstructural measures also help reduce future flood damages without reducing flood peaks. These measures include land management and treatment measures, flood forecasting, flood fighting, floodway regulation, floodplain land use planning and zoning, and floodproofing.

Land treatment measures can reduce flood damages within local areas. While they have little effect on mainstem flood damages, they complement structural measures and reduce sediment problems.

Flood forecasting and flood fighting provide opportunities for emergency measures to minimize damages by the evacuation of persons and movable objects from areas expected to be flooded and by various emergency activities to reduce the damages from flooding. Floodway regulation is aimed at preventing floodplain development, whether subject to damage or not, that would adversely affect the passage of flood flows. Floodplain land use planning and zoning involve restrictions in the use of areas subject to flooding that are appropriate with the hazards of such use. Floodproofing involves modification of buildings and other structures on the floodplain to reduce or eliminate flood damages of structures and their contents. Floodplain insurance against flood hazards would not reduce flood damages but would provide means of spreading the cost of flood losses.

The foregoing measures have potential application to the extent that they can be reasonably achieved by individual and local action in combination with existing and future state and federal programs. While these measures may tend to reduce the magnitude of future flood losses, they may not entirely eliminate the need for structural flood control measures.

Floodplain land use and management is the combined responsibility of all levels of government. There is a need for the adoption and use of legal tools, especially by communities, to control the extent and type of future development in the floodplain. To be effective, public information and education must be provided. It is necessary that the public understand the general flooding problems of a particular area or stream reach, the degree of risk involved, and the methods that can be used to reduce flood damages through proper land use regulations.

VIII. OPPORTUNITIES FOR DEVELOPMENT OF USDA PROGRAMS

Opportunities for solving identified problems and for meeting anticipated needs through USDA programs are presented in this chapter. The initiative required for using USDA program resources generally rests with the residents and landowners in the basin. Land treatment measures, such as terraces, waterways, and establishments of grass or trees, will be accomplished only when the individual landowner is motivated to do so. Other measures, such as floodwater retardation, municipal and industrial water supply, or public recreational facilities or structures, require group or community action. Land treatment measures when combined with a structural program, provide an integrated watershed management program. There is a continuing program to inform landowners of the assistance available from USDA agencies in order that they may select the combination of action programs that best meet their needs and desires.

A. Small Watershed Projects

An evaluation of the problems and needs in this basin, under present criteria, does not show any small watershed projects within the basin to be feasible for development in the next 10-15 years. Benefits from the reduction of existing floodwater and sediment damages do not presently justify the expenditures required to construct the necessary measures needed to prevent these damages. Presently, additional benefits for other purposes such as recreation and grade stabilization do not make it possible to justify projects under the Small Watershed Program in the short-range time period.

There may be opportunity for development of small watershed projects at some later time. Projected floodwater and sediment damages and an increased need for recreation, supplement water and improved water quality may provide additional benefits that will make some watersheds feasible in the long-range period (after 1985-1990).

A potential watershed in this category is Ponca Creek. This stream is a direct tributary to the Missouri River, with its outlet located about six miles upstream from Niobrara, Nebraska. The Ponca Creek drainage area is approximately 840 square miles, nearly equally located in South Dakota and Nebraska. Major problems in this watershed are floodwater, sediment, and erosion damages. These damages are moderate in the upper portion of the watershed, but become more severe in the lower reaches.

A Preliminary Investigation Report was completed on this watershed in 1965. At that time, the estimated average annual cost of the proposed structural measures was $378,000 and the estimated average annual

benefits from flood prevention were $144,000. Because of this unfavorable benefit-cost ration, no further investigations were made in this study. However, a projection of the existing damages and a re-evaluation of benefits for damage reduction and the need for water for other purposes, may justify the development of a small watershed project in the long-range period.

Another part of the basin that has long-range small watershed project potential is the irrigated area around Alliance. The major problem, other than the lowering of ground water levels, in the lack of an adequate surface water disposal system for the removal of runoff from excessive precipitation. Much of the irrigated area is damaged when flooded by these events or the yields are reduced by disruption in timely field preparation, planting, and harvesting operations.

No detailed feasibility studies have been made in the Alliance area. Reconnaissance investigations show a favorable benefit-cost ratio likely in most of the area. However, a number of obstacles discourage any short-range project planning in these areas. Existing policies in regard to channel modification and the lack of local interest within the problem area makes this at best a long-range opportunity.

B. Land Treatment and Land Use Programs

Land treatment practices are primary instruments contributing to full agricultural land and water development in the basin. It is projected that the total percent of land adequately treated will increase from the present 53 percent to 70 percent by 2020. In order to achieve the 70 percent goal, it is projected that 1,195,000 more acres will need to attain adequate treatment by 2020.

Government cost-sharing through the Rural Environmental Conservation Program, administered by the Agricultural Stabilization and Conservation Service, is available throughout the basin to assist owners and operators of agricultural land to install certain needed land treatment practices. The Great Plains Program, administered by the Soil Conservation Service, also offers long-term cost-sharing assistance. However, no attempt has been made in this study to estimate future federal expenditures required for these two conservation programs.

The areas projected for treatment in Chapter VII are expected to be adequately treated by 2020, and are as follows: (1) nonirrigated cropland -- 309,000 acres; (2) irrigated cropland -- 209,000 acres; (3) pasture and range -- 605,000 acres; (4) forest and woodland -- 55,000 acres: and (5) other agricultural land -- 17,000 acres.

The total estimated cost of this projected land treatment is $30,202,000 (see Table VIII-1). This averages out to be about 25 dollars per acre, which includes a maintenance cost of about 40 to 50 cents per acre, annually. The estimated cost of land treatment for 309,000 acres of nonirrigated cropland is $11,461,000. Land treatment for 209,000 acres of irrigated cropland, including 160,000 acres of

land to be converted from other agricultural uses to irrigation, is estimated to cost $9,308,000. Estimated costs for land treatment for 605,000 acres of pasture and range, including conversion of 46,000 acres from cropland to range, is $7,033,000. Estimated costs for forest and woodland treatment total $1,870,000, and for other agricultural land the land treatment costs total $530,000.

TABLE VIII-1.--ESTIMATED COST OF PROJECTED LAND TREATMENT
NIOBRARA RIVER BASIN 1971-2020

Type of Treatment	Area		Cost
	(Acres)		(Dollars)
Nonirrigated Cropland			
On Current Cropland			
Management Only	25,000		225,000
Mgmt., Vegetative & Mech.	239,000		9,560,000
Converted Rangeland (46,000 acres)			
Management Only	4,000		36,000
Mgmt., Vegetative & Mech.	41,000		1,640,000
Sub-Total		309,000	11,461,000
Irrigated Cropland			
On Current Irrigated Cropland			
Management Only	30,000		240,000
Mgmt., Vegetative & Mech.	19,000		1,900,000
Converted Nonirrig. Cropland			
Management Only	96,000		768,000
Mgmt., Vegetative & Mech.	64,000		6,400,000
Sub-Total		209,000	9,308,000
Pasture and Range			
Management Only	305,000		915,000
Mgmt., Vegetative & Mech	254,000		4,508,000
Converted Cropland to Range	46,000		1,610,000
Sub-Total		605,000	7,033,000
Forest and Woodland			
Management Only	22,000		220,000
Mgmt., Vegetative & Mech.	33,000		1,650,000
Sub-Total		55,000	1,870,000
Other			
Management Only	8,000		80,000
Mgmt., Vegetative & Mech.	9,000		450,000
Sub-Total		17,000	530,000
GRAND TOTAL		1,195,000	30,202,000

C. Cooperative State-Federal Forestry Programs

A number of opportunities exist for landowners to use cooperative state-federal forestry programs to obtain technical assistance for forest management and financial assistance to provide trees and plant shelterbelts and windbreaks; to supply trees for planting areas best adapted to forest production; to thin and improve timber stands; and to provide forest protection.

Funds to assist landowners with the installation of the proposed practices are supplied by both state and federal agencies. No attempt has been made in this section to determine what amounts might be furnished by any given agency. Instead the total cost of the proposed improvements have been included in the land treatment section of this chapter. Table VIII-2 lists the major opportunities for land treatment measures on state and private lands for the next 10 to 15 years.

TABLE VIII-2.--OPPORTUNITIES FOR STATE AND PRIVATE FOREST LAND TREATMENT MEASURES FOR THE NEXT 10-15 YEARS NIOBRARA RIVER BASIN, NEBRASKA

Item	Unit	Amount
Timber surveys and plans	Acres	20,000
Forest management technical assistance for timber harvesting, thinning, pruning, and releasing	Acres	10,000
Distribution of seedling trees for reforestation, shelterbelts, and windbreaks	Trees	8,000,000
Tree seeding and planting	Acres	25,000
Forest insect and disease control program-detection, salvage cuts and trimming	Acres	500
Maintain and improve fire control programs-organize fire districts, provide training, and equipment	Acres	30,000
Cooperative watershed protection and flood prevention program - livestock control and critical area treatment	Acres	50,000

Most of the forest land treatment can be installed on a cost-sharing basis through cooperation with the Nebraska State Forester. Measures installed would be maintained by the landowners and operators. Most of the merchantable volume and desirable species have been liquidated, with the result that the present average merchantable timber volumes are below those desired for industrial developments. However, there is some increased interest in localized areas, especially in the eastern portion of the basin, to improve forest management, timber quality, wildlife habitat, and recreation opportunities.

D. National Forest Programs

The program and project work inventory for the National Forest lands are designed to meet the anticipated needs of the next ten to fifteen years. The Forest Service can install the treatment needed on National Forest lands if funds are made available under its regular management programs.

Land and resource treatment measures are important features locally as well as in the basin-wide program, (see Table VIII-3).

TABLE VIII-3.--OPPORTUNITIES FOR LAND TREATMENT AND STRUCTURAL MEASURES FOR THE NATIONAL FOREST FOR THE NEXT 10-15 YEARS NIOBRARA RIVER BASIN, NEBRASKA

Item	Unit	Amount
Reforestation	Acres	2,000
Timber stand improvements, thinning	Acres	1,000
Insect and disease control	Acres	300
Recreation sites, forest improvements	Acres	30
Range forage seeding	Acres	1,600
Range fences	Miles	44
Cattle guards	Number	12
Range wells and stock water	Number	180
Wildlife habitat seeding and planting	Acres	10
Wildlife area protection fence	Miles	16
Wildlife shallow water and pothole improvement	Number	25
Road construction and betterment	Miles	180
Watershed restoration, stabilization and erosion control:		
Dunes and Blowouts	Acres	850
Abandoned roads	Miles	15
Stream banks	Miles	6

Such treatments include measures to improve range and forage management, grazing use, wildlife habitat, erosion control, stabilization of dunes and blowouts, tree planting and timber stand improvement, recreation sites, and roads and trails. These programs will facilitate and extend the multiple use management, improvement, and protection on this area of the basin.

Opportunities exist for participating in furthering the scenic and recreation rivers program in the Niobrara Basin. The multiple-use plan and program of the National Forest includes provisions for enhancing the quality and use of the lands adjacent to the Niobrara and Snake Rivers. These rivers are being considered for inclusion in national or state scenic and recreation rivers protection programs.

E. Resource Conservation and Development Projects

There is an opportunity for additional Resource Conservation and Development Projects in the Basin. These projects would provide technical and financial assistance to local groups in conserving and developing their natural resources. They would provide these groups the opportunity to coordinate the use of federal, state, and local efforts to develop these resources for economic and community improvement. Currently, it is recommended that a Resource Conservation and Development Project be authorized for Boyd, Brown, Cherry, Holt, Keya Paha and Rock Counties.

F. Water Supply and Sewage Treatment Programs

There are opportunities to install new or improve existing water supply and sewage treatment facilities in a number of the urban and rural communities in the basin. Programs of the Farmers Home Administration (FHA) can assist with these developments in communities with a population of 5,500 or less by providing grants and loans for planning and construction of these facilities. Under existing policies and procedures, it is necessary to evaluate the needs of each individual village to determine what percentage of assistance can be provided under the loan and grant program.

An analysis of the incorporated communities of less than 5,500 population shows that currently there is opportunity for FHA assistance for water supply developments in 17 communities in the basin. The estimated cost of these water supply improvements is $630,000. A portion of this amount could be eligible for assistance from FHA. Table VIII-4 groups the proposed developments, using 1970 census data.

TABLE VIII-4.--MUNICIPAL WATER SUPPLY AND SEWAGE TREATMENT OPPORTUNITIES
NIOBRARA RIVER BASIN, NEBRASKA

Category 1/ of Incorporated Communities	Improve Existing Systems		New Systems		Total	
	Places No.	Inst. Cost Dollars	Places No.	Inst. Cost Dollars	Places No.	Inst. Cost Dollars
Water Supply						
2,500-5,500	1	100,000			1	100,000
1,000-2,500	3	150,000			3	150,000
500-1,000	4	150,000			4	150,000
250-500	4	70,000			4	70,000
Under 250	5	160,000			5	160,000
Subtotal	(17)	(630,000)			(17)	(630,000)
Sewage Treatment						
2,500-5,500						
1,000-2,500						
500-1,000	3	146,000			3	146,000
250-500	2	58,000			2	58,000
Under 250	1	59,000	6	351,600	7	410,600
Subtotal	(6)	(263,000)	(6)	(351,600)	(12)	(614,600)
TOTAL COSTS	-	893,000	-	351,600	-	1,244,600

1/ Grouping using 1970 census data.

There is opportunity to assist 12 communities with the installation or improvement of sewage treatment facilities. Six of these proposed developments would be for the improvement of existing treatment systems, while the other six communities require new systems. The estimated cost for these developments is $614,000. The amount of assistance eligible under FHA programs is dependent on the amount of assistance that might be provided by other agencies of government and the existing situtation in each of the communities where the treatment facilities are proposed.

The total cost for water supply and sewage treatment developments is estimated to be $1,244,600. Current estimates, using existing policies and procedures, show that FHA assistance could provide funds for approximately 50 percent of this amount.

IX. IMPACTS OF PROPOSED USDA PROJECTS AND PROGRAMS

Proposed USDA projects and programs will affect the physical landscape, environment, culture and economy of the basin. Not all impacts can be quantified because in some instances they are not readily identifiable and may only become apparent after a development program is implemented. Proposals set forth in this report include treatments to maintain or improve the productivity of the basin's agricultural land, and to protect and conserve its land and water resources. Action or inaction in one sector directly or indirectly affects the other.

A. Physical and Biological Effects

The projected application of forestry practices and land treatment measures will reduce damaging runoff and erosion and more nearly bring about the use of land within its capability. The ultimate effects of land treatment measures will be a reduction in sediment deposition on the floodplains and in streams and an improvement in the hydrologic conditions of the basin. Proper management and treatment of all lands will result in not only less water and wind erosion, but also increased soil tilth along with increased efficiency of water use on irrigated lands. Wildlife will also be able to utilize and benefit from the revegetated areas.

Although progress in land treatment from 53% adequately treated currently to 70% adequately treated in 2020 amounts to an increase of only 17%, the effect on soil losses will be substantially higher. Soil losses from water erosion will be reduced on cropland from an average rate of about 3.3 tons to 1.7 tons per year, or about one-half of the current rate. This amounts to a total reduction on cropland of about 2.2 million tons per year. The soil loss reductions on other land uses are not as great, due mainly to the fact that current losses are fairly close to the rate of geologic erosion.

Technical assistance by Soil Conservation Service and the Extension Service to feedlot operators for planning will encourage practices to reduce the runoff of pollutants to the streams of the basin. Cost-sharing for feedlot practices, through the Rural Environmental Conservation Program and through the Great Plains Program, will assist feeders in the control of feedlot runoff.

Installation or improvement of sewage treatment facilities will result in an improved quality of effluent. This will also help accomplish an overall objective of improving water quality in the basin's streams and ground water.

B. Economic Effects

The economic impact of the proposed USDA projects and programs can be divided into two categories. First is the impact of many technical assistance programs that provide information, education, and planning assistance for many aspects of land and water resource conservation and development. It is impossible to measure the economic effects of these programs. However, they have had a significant impact in our existing economy and it is expected to continue. Second is the impact of financial assistance furnished by USDA programs. This assistance is in the form of grants, loans, or cost-sharing to assist individual landowners or organized groups of landowners and municipalities in land conservation and water resource developments.

Proposed USDA programs in the basin are to improve and maintain the existing resource. Land treatment and forest treatment measures will preserve the resource base and allow continued production of the products of the basin. Such programs as the Rural Environmental Assistance Program, the Great Plains Program, Cooperative State-Federal Forestry Program, and programs of the Farmers Home Administration assist in these measures. The projected cost for the recommended improvements for 1,195,000 acres of agricultural land is $30,202,000. The cost of management, vegetative and mechanical practices, on 659,000 acres, is $25,108,000; for management practices only, on 490,000 acres, is $2,484,000; and for 46,000 acres of land conversion the cost is $1,610,000.

The impact of the land treatment and forest treatment measures will be twofold. First there will be the impact of the expenditure of money necessary to do the initial treatment work. Second there will be the impact of the increased production of agricultural products which will be the result of higher productivity of the land over the long term period.

The existing Nebraska Panhandle Resource Conservation and Development Project and the recommended RC&D Project for the central and eastern part of the basin will also have an economic impact within the basin. Actual monetary amounts of impact generated by these projects will be dependent on the local people to implement needed improvements.

The Farmers Home Administration also has grant and loan programs that assist communities with the installation of water supply and sewage treatment facilities. The proposed developments for sewage treatment facilities in 15 villages are estimated to cost around $680,000; proposed improvements in existing water supply systems in 12 communities is estimated to cost nearly $360,000. Although no attempt was made to determine the economic effects of this program, availability of adequate water and sewage facilities may often be the deciding factor in bringing new industries to rural communities in the basin.

C. Land Use and Availability

Benefits from proposed water resource developments will generally exceed the reduction in income from the acreage taken out of agricultural production. Any shift of agricultural lands will necessitate an objective review of the potential of the remaining agricultural base to meet the goals enumerated by state or national requirements. Proposals set forth in this report include considerations of treatments to maintain or improve the productivity of the basin's agricultural land and the protection and conservation of its water resource.

Over two million acres of current agricultural land in the basin have been classed as suitable for irrigation. The current normal irrigated crop acreage is 145,000 acres, about seven percent of the total potential. Since nearly all of the irrigation development will be private, land availability will be no problem. The total crop production from the potentially irrigable land should more than double current dryland production.

D. Social and Institutional Effects

Development of water and related land resources in the basin will improve the social environment of the rural areas. The resultant increase in income and employment and/or the reduction of out-migration of people will strengthen the religious, economic, educational, and governmental institutions of the basin. The rate of reduction in the farm population should be decreased. Increased production will tend to create some additional employment in the related trade, service and processing industries. Recreation opportunities will increase as approved and proposed development measures are completed.

E. Environmental Impacts

Impacts of USDA programs will assist in maintaining and improving the environment in the Niobrara River Basin. Proposed land treatment measures will reduce soil loss; will reduce sedimentation in streams and reservoirs; will aid in the control of unsightly gullies; will reduce runoff of destructive floodwaters; and will help control feedlot pollution.

The rehabilitation and improvement of range and forest areas, including the reduction or elimination of grazing of livestock in some woodlands, will improve the appearance and hydrologic conditions within the basin. Application of forestry practices will aesthetically enhance the overall environmental landscape. The tree planting programs, including additional shelterbelts and windbreaks will help interrupt the monotony of the plains and provide protection for croplands, livestock, and wildlife.

Programs assisting with the installation of sewage treatment and water supply facilities contribute to the improvement of the environmental conditions within the basin. Resource Conservation and Development Projects also have the potential to provide developments that will lead to a better quality of life for people living within and near the basin.

When water resource planning is undertaken, the existence of negative benefits should be recognized. For instance, when irrigation is increased, the vector problem of increased mosquito infestation may increase due to the incidence of ponding. Also, it is recognized that much of the increase in irrigation expected may occur in the Sandhill area. Here the plant cover of native vegetation would be destroyed, resulting in the reduction of wildlife habitat and increased hazard of wind erosion.

Floodplain zoning, while reducing flood damage, excludes certain types of development and land use in the floodplain. There may be instances where some present occupiers of the floodplain will incur loss due to devaluation of land because of forced change of land use. Under the proposed Wild Rivers program, present users of the land might have to vacate. Also, due to the objective to preserve the Niobrara River in its wild state, no impoundments could be built even though such impoundments would be advantageous to other purposes and beneficiaries.

X. COORDINATION AND PROGRAMS FOR FURTHER DEVELOPMENT

The implementation of an orderly and comprehensive program for the conservation and development of the basin's water and related land resources should be based on coordinated proposals of federal, state and local agencies which are acceptable to the people in the basin. The Nebraska Natural Resources Commission has the responsibility to coordinate the various proposals and plans from reports and data submitted to them by the cooperating federal and state agencies.

Development should be implemented as a result of the desire of local people and will be expedited when the local people are well informed about alternative programs available to them and when they actively participate in the decision making process. Some agencies which can be called upon to provice information on programs are the Nebraska Natural Resources Commission, the Cooperative Extension Service, University of Nebraska, and many local organizations.

Major resource development proposals for the basin may be installed under the programs of the U. S. Department of Agriculture, U. S. Army Corps of Engineers, and the U. S. Department of the Interior. State and local entities of government and private interests can implement other developments required to satisfy needs of the basin. Examples of other developments are: the development of recreational areas by the State of Nebraska or appropriate political subdivisions within the basin; the continued improvement of the sewage treatment facilities by cities and villages; the increased development of private irrigation by landowners, limited primarily by supply of ground water.

A. Other Agency Programs

In addition to the USDA opportunities proposed in this report, other federal agencies have proposed, or are making studies for the Niobrara River Basin. The Bureau of Reclamation, U. S. Department of the Interior, has made investigations for six potential public irrigation projects in the basin. The primary purpose of these projects would be to increase water available for irrigation; incidentally, they would also increase flood control, enhance fish and wildlife resources, and increase water-based recreation supply.

O'Neill Unit

The O'Neill Unit is located in the central part of the Niobrara River Basin. The Bureau of Reclamation has completed a feasibility investigation and a favorable report has been submitted to Congress for authorization of the project.

Major features of the O'Neill Unit would include Norden Dam and Reservoir on the Niobrara River, O'Neill Canal, Springview Canal and Pumping Plant, and associated distribution systems. The primary project purpose would be the irrigation of 77,000 acres of land with major benefits also accruing to recreation, fish and wildlife. Some flood control benefits, incidental to the operation of Norden Reservoir for the other purposes, would accrue downstream.

The Springview Canal and Pumping Plant would serve 8,000 acres mostly on the high tablelands above the Niobrara River south of Springview in Keya Paha County. The O'Neill Canal would serve 69,000 acres on the uplands just north of the basin boundary in Holt County. Approximately 4,700 acres would be acquired and managed for fish and wildlife purposes at Norden Reservoir.

Mirage Flats Project

The existing Mirage Flats Project provides water for irrigation of about 11,660 acres south of Hay Springs, in Sheridan County. The present water supply comes from natural river flows stored in the Box Butte Reservoir on the Niobrara River. However, existing water supplies have been inadequate in most years since the project attained full development.

Feasibility studies of the Bureau of Reclamation indicate that the water supply could be economically augmented by installing 17 deep wells along the canals and laterals to pump into them. In addition to the principal benefit to irrigation, substantial benefits to recreation, fish and wildlife would result from concurrent work on the Box Butte Reservoir. Additional lands and added recreation facilities would be made available for public use.

Lavaca Flats Unit

This potential project is located along the north side of the Niobrara River southeast of Gordon. A feasibility report was completed by the Bureau of Reclamation in 1956 that indicated a wide margin of favorable economic feasibility.

As presently formulated, the project includes a pumping plant to lift water from the Niobrara River, a main supply canal and distribution lateral and a drainage system. About 2,300 acres would be irrigated by this proposed project.

Page Area

Water for irrigation of approximately 25,000 acres would come from Niobrara River flows which are in excess to the needs of the O'Neill Unit. These excess flows would be conveyed through the O'Neill Canal and the O'Neill sub-canal and stored as necessary in Eagle Creek Reservoir. A pumping plant would lift water from this reservoir into the Page Canal for distribution to the irrigable area in the vicinity of Page and Orchard, Nebraska.

The project has been studied at reconnaissance level with additional studies required to determine specific project value.

Gordon Area

The primary purpose of this potential project would be to supply irrigation water to approximately 20,000 acres of land in the vicinity of Gordon, Nebraska. Other project purposes would be flood control, recreation, and the enhancement of fish and wildlife.

Principal features of the project include Clinton Dam and Reservoir, Clinton Pumping Plant and Canal, and the distribution system necessary to deliver the water to the project lands. Clinton Dam would be located on the Niobrara River immediately downstream from the junction of Rush Creek.

To date this project has been given only limited study at reconnaissance or lesser level. Additional studies would be required to determine its feasibility.

Keya Paha Area

This project would provide Niobrara River water for irrigation of nearly 15,000 acres of land near Butte and Spencer in Boyd County. Water would be pumped and stored in McCully Reservoir located on an intermittent tributary of Ponca Creek near Naper, Nebraska. From the reservoir, water would be conveyed by gravity through the Keya Paha Canal to the irrigable area.

Only reconnaissance or lesser level studies have been completed for the Keya Paha Area. Additional studies would be required to determine its feasibility.

The U. S. Army Corps of Engineers has evaluated the proposed irrigation projects for flood control benefits. They have investigated urban areas for possible local protection projects and have made studies in Ponca Creek and the Niobrara River. They are still investigating possible solutions to the sediment deposition problem in Lewis and Clark

Lake, Gavins Point Reservoir and the associated high ground water tables in the vicinity of the town of Niobrara and Niobrara State Park. Some of the solutions that have been studied include a multiple purpose dam and reservoir on the Niobrara River upstream from Verdigre Creek; the installation of a levee-pump system; and the relocation of both the town of Niobrara and Niobrara State Park. The 1970 Flood Control Act authorized 7.8 million dollars for relocation. A master plan for a new town site is being developed.

The Bureau of Sports Fisheries and Wildlife has a plan to improve recreational facilities at the Fort Niobrara National Wildlife Refuge near Valentine and the National Park Service has programmed the development of the Agate Fossil Beds National Monument in Sioux County.

Reaches of the Niobrara and Snake Rivers have been selected for status and classification under the Wild, Scenic, and Recreation Rivers Act (P.L. 90-542, of October 2, 1968). The specific reaches involved are the Niobrara River from its confluence with Antelope Creek downstream to the headwaters of the proposed Norden Reservoir in the vicinity of Sparks, Nebraska, and including the lower eight miles of the Snake River tributary below the Merritt Reservoir.

In addition to the above, the upper reach of the Snake River, from its headwaters to the headwaters of Merritt Reservoir has valuable natural characteristics that may qualify it for federal or state designation as a scenic or recreation river. The State of Nebraska has selected this reach of the Snake River to be included in the list of rivers for studies and investigations to determine its potential for addition to the National Wild and Scenic Rivers System.

Several other nonfederal agencies are active in developing various aspects of the basin's land and water resources. The Nebraska Game and Parks Commission has prepared an outdoor recreation report for the state and has a continuing program of acquisition and management of land and water for recreation and fish and wildlife purposes. Local and county governments construct and operate needed developments for a variety of purposes.

The laws of the State of Nebraska provide for floodplain zoning and land use regulation. The implementation of these zoning statutes will deter or limit the installation of developments in areas subject to flood damages. Although various agencies are able to assist in the preparation of needed reports, the implementation of zoning and land use programs is the responsibility of the state and local government.

B. Potential Developments Needing Further Coordination With Other Agencies

The projects proposed by the Bureau of Reclamation, Corps of Engineers, and other agencies should be coordinated with the U. S. Department of Agriculture in the administration and application of land treatment measures. Coordination is needed with the Bureau of Sport

Fisheries and Wildlife and the Nebraska Game and Parks Commission to obtain maximum development of agricultural and wildlife resources.

C. Alternatives

A coordinated comprehensive program oriented toward a balance of economic, social, and environmental objectives would provide the most desirable development of the land and water resources of the basin. This program would have the combined effect of improving the economic and environmental condition of the basin by providing improved water supplies, and enhancing or preserving the natural values of the environment. The quality of air, soil and water resources would be improved as well as the plant and wildlife communities. Such a comprehensive program would most nearly achieve all objectives for water and related land resource development for the greatest good of the basin's residents.

Although this report endorses this type of comprehensive program, other alternatives need to be considered before implementing a final plan for the basin.

One such plan could be oriented toward environmental objectives as the primary consideration in determining the best use of the resources. The environmentally oriented plan would give emphasis to such items as public recreation, fish and wildlife development, preservation of wooded areas along streams and near centers of population, pollution abatement, water quality improvement, and beautification. Secondary consideration would be given to the agricultural sector of the economy. This environmental type of plan would, in many instances, limit the potential for full economic development of the agricultural sector of the basin's economy. For example, water for low-flow augmentation needed to improve water quality and the fisheries resource might preempt a water supply for irrigation. On the other hand, the improved environmental condition made possible under this alternative approach might create new employment opportunities in recreational oriented industries which would help to attract other industrial oriented developments. Full implementation of this alternative approach is not possible under present USDA programs.

Another comprehensive plan could include consideration of structural measures, land use regulations, and zoning of floodplains to minimize flood damages. An alternative to this type of development would be to implement only the land use and zoning aspects of the plan which would reduce damages to future developments, but would have little beneficial effect on current or projected damages to existing developments.

Yet another alternative would be to continue only the present programs of soil and water resource conservation development instead of the accelerated program proposed by this report. In general, present programs satisfy some basic individual and local needs, but seldom provide for basinwide or statewide requirements. If present programs continue

as in the past, federal cost-sharing and technical assistance will be needed at or near current rates.

D. New Programs or Modification of Existing Programs

Changes in technology will continue to occur, which may result in new regional and national objectives. Existing programs have been and will continue to be modified to meet changing needs. The emphasis on conservation in the past has been largely focused on erosion control in order to maintain fertility and productive capability of the land. Now and in the future, emphasis on conservation will also include environmental concerns such as improvement of water quality, reduced eutrophication of lakes and impoundments, and overall landscape beautification.

Changing public demands and values will necessitate programs to provide more incentive for landowners to adequately participate in all phases of soil and water conservation programs and will increase the level of conservation treatment, improve and increase wildlife habitat and recreation opportunities, and provide for a general enhancement of the environment. Measures contributing to these objectives would include: for croplands -- minimum tillage, terraces, diversions, and vegetated waterways; for pasture and rangelands -- proper grazing management, range revegetation with permanent grasses, and weed and brush control measures; for forest and woodlands -- improved forest management, tree planting for higher grade forest products, and elimination of damaging grazing.

A program is needed to provide incentive for basin landowners to properly manage existing woodlands and shelterbelts. An approach could be cost-sharing to manage forest lands for forest products, and for recreation and environmental enhancement. Incentives could be provided to encourage establishment of markets for low-grade forest products, such as pallets, pulp material, and wood chips which would provide additional income to forest landowners and local processors.

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